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General Science A Factor In Race Betterment

BERTHA M. CLARK, William Penn High School, Phila.

The following article was prepared by Dr. Clark in co-operation with a committee consisting of Mary C. Patterson, May I. Laramy and Helen B. Shriver.

There are two fundamental instincts common to all life, the one for food and the other for reproduction. Physical hunger results in a search for food, sexual hunger results in a search for a mate.

The major part of the activities of all living things centers about these two instincts, food getting and offspring bearing. Food getting results in *self* preservation. Since self preservation and race preservation make up the larger part of life's activities, they must be continually emphasized in any course which deals with the "science of every day life" that is in a general science course.

Food getting among primitive peoples was a simple matter; wild berries, fleshy roots, good luck in the chase and man survived. Food getting with the modern man is complex; only by intensive cultivation of the soil and by careful breeding of animals does he survive. Food for self preservation demands a wide understanding of plants and animals; how they grow, how they are improved, how best harvested or slaughtered; their food value; their digestibility, their preservation from decay, and their transportation, etc.

Food getting is *essential* to self preservation but does not *guarantee* self preservation. Most plants and animals must have air and water as well as food, and man needs shelter and clothing, tools and equipment. Then there is the larger problem of personal health, the building up of physical resistance against

disease, the safe guards against infection, the safety first devices against accident and the first aid treatment in injury. Many topics therefore, must be presented under self preservation.

But it is upon *race* preservation rather than upon *self* preservation that general science must lay its emphasis. This is because race preservation is a stronger and more dominant instinct than self preservation. The instinct of race preservation alone explains the grinding sacrifices made by parents for offspring, the willing hardship and death of volunteers in the late war, and the heavy taxation endured for the erection of research laboratories, free clinics, hospital and day nurseries.

The instinct of race preservation is not common to man alone but is found among all plants and animals. A mother eagle fights even unto death for the safety of her young. Some plants, as the sweet pea, die after they have put forth efforts to produce seeds for a new generation.

All normal living things show external evidence of sexual instinct. Plants produce blossoms and often these blossoms are so exquisite in color and fragrance that even the insects are attracted to them and by their visits accomplish unintentionally, the purpose for which the blossom was produced. As a result of this pollination the plant is able to provide for a new generation. Animals mate and two of the most beautiful illustrations of this sex instinct are the sweet song and the brilliant coloring of the male cardinal and the scarlet tanager. Men marry and the literature of every nation is filled with song and story telling of this love and teaching us that this fine instinct is not unique in our own experiences but is general the world over.

General science must take up the story of race preservation; must teach reproduction among plants, animals and man; must emphasize plant and animal breeding not only from the standpoint of increased food supply but from the standpoint of human improvement; must discuss feeble mindedness, or similar inherited diseases and so bring in naturally the larger subject of heredity; must discuss heredity and the responsibility it places upon individuals who would mate, and the hope that it offers for the preservation of the good and the elimination of the bad: must urge health measures as a social responsibility as well as an individual asset; must discuss a house and its equipment not

as a mere shelter but as a home with responsibilities to the others as well as privileges for one's self.

Of course, no general science teacher would state bluntly and immediately to her pupils the two fold aspect of life as outlined above. They would not understand it. But the teacher must have this aspect in her own mind and must be guided by it in her choice of material, in her presentation of material, and in her deductions from these.

General science must give the high school pupil a scientific introduction to human sex relations. Every general science course teaches the parts of a flower, pollination and fertilization. The general science teacher who looks ahead to practical lessons in human reproduction will usually speak of male and female organs in place of stamens and pistils; will emphasize the male life principle or sperm cell in the pollen tube and the female life principle or egg cell in the ovary. Individual experiments on blossoms adopted for cross pollination as the scarlet sage and snap-dragon should be worked out. Cross pollination versus self-pollination should be considered. State laws regulating the marriage of cousins could well be discussed here. Are they necessary? This would also be a good place to consider the decay of the royal family of Spain, for example. Why has intermarriage played a part in that decay? Under what conditions would intermarriage not have played a part in the decay? This is an excellent opportunity to bring home to young people the importance of selecting a proper mate! As the story of pollination and fertilization is unfolded more in detail the opportunity repeats itself to refer to the male cell or sperm in the pollen and the female cell or egg in the ovary.

In working out cross pollination and fertilization, the teacher should state again and again that *the same law holds for both plant and animal breeding.* Just as the variegated red and white flower is the result of crossing a red flower with a white one, so the mulatto is a result of a cross between black and white parents, and a mongrel dog the result of a cross between unpedigreed specimens.

This should be followed by a discussion of the success of plant and animal breeders in securing new and improved varieties of plants and animals such as the cactus dahlia, the well filled ear of corn, the hornless cattle and the ancorn ram.

The teacher should emphasize the fact that race preservation shows itself in more ways than in the mere production of healthy vigorous offspring. To give the young all possible advantages in the early stages of life is an instinct common to many living things. Thus the plant lays by a store of food in the sed; this insures a start in life for the embryo plant. Sometimes the seeds are protected by special structures—as the prickly bur of the chestnut. The parental instinct of insects provides protection for the eggs and food for the young but goes no farther.

The mother bird not only stores nourishment in the egg and thus supplies the embryo with food until the time of hatching but often with the help of the male bird she feeds the young until they are able to forage for themselves.

Mammals carry parental care still further suckling the young after birth and carefully watching over them, and in the *human family* providing for the offspring during long years of infancy and adolescence.

Contrast the numerous offspring of fish with the spare offspring of birds and mammals, especially man. Study the parental care received by the different groups of animals. What relation exists between the length of the period of infancy and the higher development of the individual?

Since the environment into which offspring are hatched or born may determine whether or not they shall grow to maturity. it is necessary to study the effect of environmental factors such as air, water, food, bacteria, clothing and heat, etc., upon living things, especially man.

CONTENT OF GENERAL SCIENCE COURSE

FOR SELF PRESERVATION. FOR RACE PRESERVATION.

I. Food.
   1. Need of food by living things: growth, repair, heat, energy, etc.
   2. Sources of food.
      Green plants, inorganic matter.
      Animals and man, organic matter.
   3. *Plants* as manufacturers of food: where made, how made, etc.
   4. *Animals* as consumers of food: classes of foods, and what each does.
      Proteins, fats, minerals, water, starch.
   5. *Man*—need of balance diet: standard menu, cooked versus uncooked food; effect of heat upon starch, etc.

II. Water.
   1. *Plants*: How obtained, why needed; transpiration, effect of transpiration upon climate, relation of foods to humidity.
   2. Animals, how obtained in general, why needed, etc.

3. Man; *for drinking.*
   Proper quantity per day; value to body, excretion of surplus supply.
   Contamination of drinking water; dangers of; purification of contaminated water by boiling, filtration, etc.
   Sources of drinking water in cities, villages, farms.
   Man; *for bathing and laundry.*
   Bodily cleanliness; hot versus cold water as cleansing agent; hard or soft water; softening agents, soap, etc.

III. *Air.*
1. Composition of *Air.*
   a. *Oxygen*; laboratory preparation and properties. Physiology of respiration; mouth versus nose breathing; adenoids; oxidation and combustion.
   b. *Carbon dioxide*; laboratory preparation and properties.
      Source of CO^2 in nature; plants as removers of CO^2; relation of forests, parks, etc. to health; fire extinguishers, carbonated drinks.
   c. *Water vapor;* source of in air; relation to bodily activities, and health.
2. Ventilation-man.
   a. Reasons for; body heat, moisture, odor, etc.
   b. Dangers of inadequate indoor ventilation.
   c. Scientific methods of ventilation.

IV. *Body protection against temperature changes.* (climate)
1. In plants; loss of leaves; bud scales, etc.
2. In animals; furry coats, hibernation, etc.
3. In man. *Clothes*
   a. Proper clothing for different seasons.
      Furs in summer? Low shoes in winter?
      Advantages and disadvantages of woolen and cotton underwear.
   b. Materials used in clothing; plant and animal fibres; metals in hooks and eyes, etc.
   c. Proper care of clothing; brushing, airing, laundering.
   In man. *Homes*
      Different fuels, different heating systems; spontaneous combustion; uncontrolled fires; loss by fire, etc.

V. Health standards—personal and public
1. Exercise; when, where, how, quantity
2. Sleep—adequate hours, ventilation.
3. Cleanliness—tub and sponge bath; hair, nails, teeth cleaning, etc.
4. Causes and prevention of communicable diseases.
5. The micro-organisms:[1] their discoverer; their nature.

A. Their Association with Disease.
   1. Are they the products of disease?
   2. Are they the cause of disease?

B. How do micro-organisms produce disease?

C. Why are we not all ill or dead?
   Harmless organisms.
   Harmful organisms.
   Body defences; immunity.

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1 Adapted from Macfarlane's Microbiology.

HOW WE BECOME INFECTED.

A. The micro-organisms already in us.
Harmless organisms—familiar organisms—commensal organisms. Are they always harmless?

B. The strange micro-organism that get into us.
  a. By accident.
  b. By intention. Parasitism. What is a Parasite?

C. Where do they come from?
  a. Air, soil, water, foods.
  b. Animal friends.
  c. Human friends.
    Well people—carriers.
    Ill people—
      Through direct contact.
      Through indirect contact.

PREVENTING DISEASE

A. By avoiding the cause.
  1. Keeping the infectious agents out:
     Out of the home—purification of the water supply; inspection of dairies and pure milk supply; inspection of markets and wholesome food supply.
  2. Keeping the infectious agents in:
     a. In their homes—scarletina, diphtheria, measles, etc.
     b. In asylums—examination of the well for carriers of micro-organisms during epidemics, and the segregation of those found so long as they are carriers.

B. By increasing the body defences.
  1. By vaccination—smallpox.
  2. By antitoxination—diphtheria.

C. By exterminating the cause.
Pasteur's dictum—"It is in the power of man to cause the infectious diseases to disappear from the earth."
  1. By exterminating the insect vectors: malarial fever; yellow fever; typhus fever.
  2. By exterminating the animal carriers: plague-rats.
  3. By exterminating both the insect vectors and the animal carriers: African sleeping sickness—Tse-tse flies, antelopes.

VI. Scientific use of materials
  1. *Acids*, chemical properties: presence in foods, gastric juice, medicines etc.; household acids; commercial acids for tanning leather, etc.
  2. *Bases*, chemical properties: presence in medicines, in digestive tract (effect of acid mouth upon teeth)in cleaning and scouring agents (washing powders borax, soaps, metal polishes)
  3. *Salts*, chemical properties: neutral salts bath salt; precipitated salts (in home medicine chest).

RACE PRESERVATION

VII. Reproduction—sexual
  1. The flower-parts; function of each part.
  2. Pollination-protection of male cell in pollen grain; of female cell in ovary; ways by which pollen reaches stigma.
  3. Fertilization: how male cell unites with female cell; fertilizes egg cell; development of seed or offspring; young plant within the seed.
  4. Plant survival due to: large number of seeds produced; protection of seeds; food stored within the seed for embryo; wide dispersal of seeds.

5. Comparison of self and cross pollination.
   For quality and quantity of offspring; compare with animal life. Why may marriage of first cousins be unwise?
6. How self pollination is prevented.
   Male and female organs ripen at different times; male and female organs are on different plants; male and female organs refuse to be pollinated.
7. Man's ways of producing new and better varieties of plants.
   a. Cultivation—contrast ancient and modern agriculture.
   b. Hybridization—cactus dahlia, variegated flowers—Burbank's work.
   c. Selection—thornless cactus, full ears of corn.
8. Animal breeding. See plant breeding, police dogs, race horses, mules, egg laying hens, milk-cows versus beef cows, homing pigeons.
9. Human crosses. Race betterment.
   a. Creoles, Mulatoes, French Canadians.
   b. Disastrous effects of intermarriage (Royal family of Spain).
   c. Effect of intermarriage among the feeble minded (Kallikak family).
   d. Effect of sterling ancestry upon progeny (distinguished families) as of Jonathan Edwards and Theodore Roosevelt.
   e. Probability of improvement in human race by wise choices of a mate.

Reproduction—A sexual
Plants: bulb, tubers, cuttings, yeast, etc.
Animals: mention only.

VIII. Animals and their families
1. Insects
   a. Origin of a new insect.
      1. Male cell or sperm cell from father's body unites with female cell or egg from mother's body.
      2. How and where the sperm fertilizes the egg.
   b. Life history of an adult:
      1. Structure of an adult; complete and incomplete metamorphoses.
   c. Egg laying instinct.
      1. Number of eggs; protection of eggs, etc.
   d. Social life—communal life among bees and ants.
   e. Economic importance.
      1. Household pests; garden and orchard pests.
      2. Silk worm, honey bee.
2. Fish
   a. Organs of reproduction; fertilization.
   b. Development of fertilized egg; young fish with yolk attached; adult.
   c. Parental instinct shown in egg laying habits, etc.
3. Birds
   Nest building, mating, care of eggs, care of young; protectors of world's food supply.
4. Mammals
   Sexual instincts from lowest to highest mammals.
   General review of plant and animal reproduction.

Status of General Science in High Schools

C. R. Maxwell, Dean of College of Education, University of Wyoming.

In a course in educational investigation[1] it was decided to find out the status of general science in representative high schools belonging to the North Central Association. The following questionnaire was sent to 150 schools:

City ____________ State____________ School____________
Do you teach general science?__________What grade?__________
In what year was the course introduced?__________________If you have discontinued teaching general science, in what year did you discontinue? ___________________Why? ___________________
____
____
Do you intend to continue teaching general science? _____________
Why? ____
What text do you use? ______________________________________
If you do not have a course, do you contemplate establishing one? _____________________In what grade do you think general science should be taught? __________________Why ________________
____
____

Replies were received from 100 schools, representing all types of high schools from the large metropolitan high school to the smallest high school that could meet the requirements of the North Central Association. Because of the representative character of the schools investigated, the results undoubtedly indicate the present practice in the schools of the central states.

The questionnaire reveals that seventy-one schools teach the subject and twenty-nine do not. The following table shows the grades in which the subject is taught:

9th grade	55	7th and 8th grades	1
8th grade	7	8a and 9a	1
8th and 9th grades	3	11th grade	1
9th and 10th grades	3		

Until 1912, general science was a subject rarely found in the program of studies of a high school. In fact, only one school of this list had introduced it earlier. From 1912 to 1916, the number of schools introducing it each year increased quite consistently. Since 1916, there has been a relatively small number introducing it. Five schools that do not now teach the subject have taught it in the past, and three that are now teaching it plan to

1 Mr. William Penland, at present graduate student in science at Harvard, assisted in the investigation.

discontinue it as a subject of study. Seven schools that do not now teach it, plan to introduce it some time in the future.

The reasons for discontinuing the subject are of the following type: "Gets nowhere;" "Eastern colleges do not recognize the subject;" "Inability to secure adequately trained teachers." The latter statement seemed to be given as the reason for the lack of success in teaching the subject. Two people stated quite at length that their teachers were trained in the specific sciences and were unable to make the necessary adaptation of material to the needs of children in the first year of high school. Nearly everyone who answered the questionnaire gave the reason for continuing it. Typical answers are as follows: "So as to reach many who drop out before graduation, and to furnish a background for those who remain in school;" "Course is compulsory because too many students do not take any other science course during their high school career and we feel that all students should have an idea of the laws of science;" "It gives the student a broader knowledge of sciences that follow;" "It is much more interesting than physical geography which it has replaced." This latter reason was given so many times that apparently general science has replaced physical geography as a first course in science. The schools that are planning to introduce it are apparently dissatisfied with their present introductory course.

The text books used are the ones mentioned by Trafton in his article, "The Comparison of Textbooks," in General Science Quarterly for May 1920. It is interesting to note that two of these books are as widely used as all the others combined.

It was felt by asking the question, "In what grade do you think general science should be taught," would indicate whether or not the organization of the junior high school would tend to influence the introduction of general science in an earlier year. The following table shows the opinion of the people in the schools in which the subject is now taught as to the most desirable year for instruction in the subject:

9th grade	43	9th and 10th	2
8th or 9th	12	7th or 8th	1
8th grade	7	10th	1
7th, 8th and 9th	4	11th	1

The first table indicates that 77% of the schools now teaching the subject teach it in the 9th grade, but only 60% feel that

this is the best place for the subject to be taught. The replies show a decided tendency, particularly where there is the junior high school organization, to introduce the subject in the earlier years of the junior high school course. Almost without exception it was advocated that the subject be introduced as early as the 8th grade. Many people gave the following reasons for introducing it at this time: "The earlier years of junior high school present the most active interest on the part of the child;" "To connect the nature study of the lower grades with the specific sciences in high school;" "To give children a longer period in which to gain familiarity with the concepts of scence."

Replies to this questionnaire indicate:

1. That general science is a subject that is in high favor with the schools belonging to the North Central Association.
2. That a great majority of the schools introduced it as a subject of study from the years 1915-17.
3. That the great majority of the schools feel that it is the best type of science work for an introductory course.
4. That as the junior-senior high school organization is extended, the subject will be introduced in the early years of the junior high school.

In fact, the responses show that the sentiment in these schools is wholly in accord with the recommendations of the committee on the reorganization of science in secondary schools.

The Storm

I watched the countless snowflakes fall,
A blinding swirl, that settled down
On hill and plain, and like a pall,
Half hid from sight my dear old town;
It darkened all my living room,
Obscured the sun, shut out the sky;
I saw no beauty, only gloom,
And felt the chill of night draw nigh.

But when next morning I arose,
Diamonds were sparkling everywhere;
Each bough and twig the fallen snows
Had decked with shining gems and rare;
The air was clear, and in the sky,
Unswept by clouds, the sun shone warm;
The earth was clothed with majesty
And beauty, children of the storm.

So fall, O God, upon each soul
Thy drops of goodness, stainless white;
And when we lose our self-control,
See only gloom and comin night,
Give us a faith in One Fixed Star,
And make our blinded eyes to see
The beauty in the Days That Are,
The glory of the Days To Be.

Christmas, 1920. C. H. Stone.

Studies of The Masters

VII. GALILEO—(*Concluded*)

By JOHN F. WOODHULL.

"Truth forever on the scaffold, wrong forever on the throne."

The years 1609 to 1611, in which Galileo invented and perfected the telescope, were years of incessant labor and feverish excitement. In rapid succession he discovered the satellites of Jupiter, the rings of Saturn, the spots on the sun and the fact of its rotation on its axis, the mountains and valleys on the moon, the fact that the moon turns always the same face toward the earth, the librations of the moon, the true cause of the visibility of the dark side of the moon, the nature of the milky way, countless nebulae and star clusters, the fact that stars appear in the telescope as points and planets as disks with the correct inference regarding their relative distances, and the fact that Venus exhibits phases like the moon. Andrew D. White says: "Herein was fulfilled one of the most touching of prophesies. Years before, the opponents of Copernicus had said to him. 'If your doctrines were true, Venus would show phases like the moon' Copernicus answered: 'You are right, I know not what to say; but God is good, and will in time find an answer to this objection.' The God-given answer came when, in 1611, the rude telescope of Galileo showed the phases of Venus."

Galileo had long believed in the Copernican theory of the universe, but until now had not had the means of applying his favorite method of study to the problem. Now that he saw the truth as a demonstrated fact and no longer open to doubt or argument, he began vigorously to spread it abroad. This enraged the Aristotelians, some of whom "refused to look through the telescope, lest they should see, others convinced they could not see, things of which Aristotle had made no mention". One of Galileo's colleagues on the faculty of Padua died in 1610, having refused persistently to look at Galileo's "absurdities". Him Galileo felicitated on the opportunity of seeing these "absurdities" on his way to heaven.

To Kepler, Galileo wrote "I think, my Kepler, we will laugh at the extraordinary stupidity of the multitude—Verily, just

as serpents close their ears so do men close their eyes to the light of truth. To such people philisophy is a kind of book, where the truth is to be sought, not in the universe or in nature, but by comparing texts! The first philosopher of the faculty at Pisa tried hard with logical arguments, as if with magical incantations, to tear down and argue the new planets out of heaven". Here is an example of the way these "peripatetic" logicians argued: "Animals that are capable of motion have joints and limbs; the earth has neither joints nor limbs, therefore it does not move." And here is another example: Sizzi, an Aristotelian astronomer, said "there are seven windows of the head; two nostrils, two eyes, two ears, one mouth; there are seven metals and seven days in the week. Now if we increase the number of the planets, this whole beautiful system falls to the ground". Sizzi obstinately refused to look through the telescope lest the truth might prevail. Eight years later he was convicted of a crime and broken on the wheel!

Oftentimes a score of such philosophers would violently attack Galileo at one time. Before replying to their arguments, he himself would amplify and enforce them with new grounds of plausibility, so as to leave them in more ridiculous plight when he afterwards overturned them all.

Never was a man so persecuted for his discoveries and for setting forth demonstrated facts. He was compelled to expend an enormous amount of energy and time in defending himself for more than fifty years against the incredible rage of his enemies. His old friend Sagredo of Padua urged him to let fools be fools, let the ignorant plume themselves on their ignorance, why court martyrdom for the sake of winning them from their folly?

Galileo was guilty of the same sins as Abraham and David. For these iniquities the church of that day had no rebuke indeed the authorities on one occasion increased his salary avowedly so that he might the better care for his illegitimate children, of whom he had three and for whom he cared most faithfully. He was never married. In the eyes of the church Gaileo's one and perhaps only sin was his uncontrolable passion for telling the truth about his discoveries with the telescope.

The church however did not always consistently and infallibly take it's stand against the Copernican system. Cardinal Barberini, soon to become pope Urban VIII, wrote to Galileo in 1620 inclosing a poem which he himself had written celebrating Galileo's discoveries: "The esteem, which I always entertain for yourself and for your great merits, has given occasion to the enclosed verses. If not worthy of you they will serve at any rate as a proof of my affection; while I propose to add lustre to my poetry by coupling it with your renowned name. Without wasting words in further apologies. I beg you to receive with favor this small proof of my great esteem".

Pope Urban delighted in Galileo's books and frequently wrote him in highest commendation of them. Of one he wrote: "It is the only book which can induce me to withdraw for a few hours from my official duties to devote myself to its perusal, and to the observation of the planets of which it treats—if the telescope we have here is fit for it. (Galileo had given him the telescope.) I beg you not to forget the high opinion which I entertain for a mind so extraordinary gifted as yours." The pope did not mind looking through one of Galileo's iniquitous telescopes even if the Aristotelians and Jesuits did.

Galileo's book "Il Saggiatore", a masterpiece of ingenuity, a model of dialectic skill and an ornament of classical Italian literature, particularly delighted Urban and he had it read aloud to him at table. This book was destined to accomplish the overthrow of Galileo. At the very time the pope was having it read to himself as one of his special delights, the general of the order of Jesuits forbade the members of that Order to read it or speak of it even among themselves.

In 1623 Urban was looking forward to a visit from Galileo and his secretary writes to Galileo: "Your arrival will be most welcome to his Holiness. He asks me if you are coming, and when, and in short seems to love and esteem you more than ever"—"Nothing pleased his Holiness so much as the mention of your name. It will give him great pleasure for you to come if it is not inconvenient to you, and if the journey would not be injurious to your health; for great men like you, he said, must spare themselves so that they may live as long as possible".

All the world of Rome at this time was aware of the favor in which the pope held Galileo. His enemies dared only to

clench their fists behind his back. The pope loaded him with favors. He legitimized his illegitimate son! He promised a pension for the son. He gave Galileo a picture of himself; a gold medal; a silver medal; and he wrote an official letter in which he said "the fame of our philosopher's services to science will shine on earth so long as Jupiter and his satellites shine in heaven"—"We have observed in him not only literary distinction, but love of religion, and all good qualities worthy of the Papal favor. We give this honorable testimony to his virtue and piety." Poor Galileo! So soon to be considered by the same pope the greatest scandal to all Christendom! Gallileo himself received an annual pension of 100 crowns from the pope from 1630 to his death in 1642,—a most remarkable circumstance! In 1624 the pope declared to one of Galileo's persecutors that "the Church had not condemned the Copernican doctrine; nor was it to be condemned as heretical". In 1631 the pope was looking forward to the publication of Galileo's new book the Dialogues, and he vowed that when the book appeared he would read no others than it and his Breviary.

One of the monks told the pope that he had tried to convert some German nobles to the Catholic faith and that they were favorably disposed until they heard of the prohibition of the Copernican theory, when they indignantly declined to have anything more to say to him. The pope replied: "It never was our intention, and if it had depended upon us that decree would not have been passed."

But Urban proved to be a poor protection against the onslaughts of calumny from Galileo's enemies. They at length convinced Urban that Galileo had intended to ridicule him in his Dialogues. A preposterous and wholly baseless charge. But calumniating propaganda has always had an unaccountable vogue among mankind. The Jesuits knew that the vanity of Urban was his great weakness, and they shrewdly worked upon it. J. J. Fahie says: "So vain was Urban VIII that he caused documents to be forged to prove his family to be one of the oldest and most noble of the Florentine stock. He is noted in history for three things; (1) excommunication of all who took snuff in churches. (2) persecution of Galileo: and (3) the foolish campaign against the Duchy of Castro. He was a monument of weakness, vanity, arrogance, and ambition."

He suddenly discovers that Galileo's opinions are in the highest degree pernicious to the church. He snatches his old friend seventy years of age, from a sick bed and has him brought on a litter all the way from Florence to Rome to be tried by the Inquisition. The Inquisition had burned Bruno a few years before for holding the opinions which Galileo now held; a few years before also Antonio de Dominis was saved from burning by dying in the dungeon of the Inquisition. His crime was explaining the rainbow as Galileo did and as every school child is now taught to do. Three physicians testified that Galileo was not able to take the journey, but would be likely to die on the way, to which His Holiness replied that he must come or be brought in chains. What happened in the weary months which followed at Rome is a most sickening story. It is best told in J. J. Fahie's life of Galileo, and cannot be suitably condensed for this article.

Galileo recanted. Much has been made of that fact. I am free to say that I am glad he decided not to burn. It requires much fanaticism and some egotism for a man to think that the progress of truth will be greatly helped by the blaze which he may feed. Those who require other people to be martyrs are perhaps related to those who demanded the sacrifice of some life in gladiatorial contests and bull fights.

Consider Galileo's plight. He was seventy years old. He was a very sick man and chronically so, without prospect of ever returning to health. There was no illusion in his mind concerning the hatred which the Aristotelians and Jesuits entertained for him, nor concerning their will and their power through the Inquisition to destroy whomsoever they found inconvenient to have about. Deaths by burning, by torture and by lingering in the unwholesome dungeons of the Inquisition were commonplace occurrences; too common to be glorious, or to greatly affect the minds of men toward truth.

But above all, Galileo was a devout catholic, even to the extent of believing that the pope was divinely appointed to correct his own errors of judgment, and, if need be direct his thinking. Now, when the pope suddenly turned from being his staunchest friend to being an implacable enemy, he was completely stunned.

Whatever Galileo may have hoped to accomplish by a few more years of life, the indubitable fact is that he did vastly

more for the truth by living than he could have done by dying. If he had died, he would not have met John Milton, and through his writings impressed all future ages. If he had died, he would have missed the chance to add Torricelli and several others to the list of his disciples who were to carry on his good work.

This turn of the tide occurred in 1633. For the remaining eight years of his life the Jesuits had the upper hand and were permitted to persecute him to the full extent of their evil hearts. They shamelessly boasted that "if he had only known how to retain the favor of their order he would have stood in renown before the world, he would have been spared all his misfortunes, and could have written what he pleased about everything—even about the motion of the earth." His disgrace was not due to his writings nor his opinions, but to his having stirred up the enmity of the Company of Jesus.

This debauched priesthood was once shocked at the proofs of a sexual system in plants.

Galileo's works were prohibited to be published in Italy and this prohibition lasted for more than a hundred years. But infallibility is manifestly temporal and ephemeral. At the present time all of Galileo's writings are published at the expense of the Italian government, and there is a grand collection of Galilean books and manuscripts in the Bibliotica Nationale in Florence comprised in some 303 large volumes owned by the government. Has any other author such glory?

In 1634 his favorite daughter, Sister Marie Celeste, died and a few days after he believed himself to be dying and said "I hear her constantly calling me." In 1637 he became totally blind and soon after almost wholly deaf. In 1638 John Milton, aged 29, visited him, blind and broken, and wrote: "I found and visited the famous Galileo, grown old, a prisoner to the Inquisition for thinking in astronomy otherwise than the Franciscan and Dominican licensers thought."

"Little then
Did Galileo think whom he received;
That in his hand he held the hand of one
Who could requite him — who would spread his name
O'er lands and seas-great as himself, nay, greater;
Milton as little that in him he saw,
As in a glass, what he himself should be,
Destined so soon to fall on evil days
And evil tongues — so soon — alas, to live
In darkness, and with dangers compassed round,
And solitude".

Paradise Lost contains many references to Galileo. Milton was like Galileo in independence of thinking "Never was there a more unconfined mind. He had that universality which marks the highest order of intellect. He travelled over the whole field of knowledge as far as it had then been explored."

The last three months of Galileo's life the famous Torricelli, his faithful and devoted disciple, spent with him and cared for him.

In 1642, at the age of 78 years, he breathed his last, and Isaac Newton, on whom his mantle was to fall, breathed his first breath.

His Holiness would not allow a man "who had caused the greatest scandal to all Christendom" to be suitably buried and the friends of the great dead were constrained to hide away (there was not even an epitaph) his beloved remains in a little room or cell, where it remained for a century lacking five years.

But in 1737, "in the presence of the leading clergy, of the professors of the schools of Florence and Pisa, and of learned literary, and artistic men from all parts of Italy, Galileo's remains were removed with great pomp to the mausoleum in the north aisle of Santa Croce—the Pantheon of the Florentines," and a magnificent monument was erected.

An exquisite temple, the *Tribuna di Galileo*, was finished in 1841. It is on the first floor of the Museum of Physics and Natural History in Florence, and is "dedicated to the memory of the great Galileo, the father of experimental philosophy, destined to preserve the scientific instruments, etc.—the products of his genius."

He exemplified with brilliant success the method by which experimental science has wrested from nature so many of her secrets. By the combination of experiment with calculation and the transformation of the concrete into the abstract he forstalled a great part of Newton's work. It is of course impossible to give an adequate account of his great labors in a paragraph, but the wide extent of his inventions, discoveries, and researches may be suggested by such a list as follows:

Principle of inertia, theory of projectiles, virtual velocities, laws of equilibrium, theorems of hydrostatics, laws of floating bodies, laws of the pendulum, laws of falling bodies, and of uniformly accelerated motion, relations of force and motion, meth-

od of applying mathematical analysis to physical problems, the proportional compasses, the pulsilogia, the astronomical clock, the thermometer, the microscope, the telescope, the demonstration and defense of the Copernican doctrine, surmises upon gravitation, the velocity of light, and many principles of mechanics, heat and light, mountains and valleys of the moon, earth shine on the moon, librations of the moon, nature of the milky way, nebulae, Jupiter's satellites, Saturn's rings, sun's spots, rotation of the sun, method of determining longitude, etc.

Professors and priests in that day wrote not in the vernacular but in Latin. Galileo had no patience with this sort of pharisaism. He said "I write in Italian rather than Latin because I wish every one to be able to read what I say - - - I want people to know that as nature has given eyes to them just as well as to philosophers for the purpose of seeing her works, so she has given them brains for examining and understanding them." He wrote in a style adapted not for the learned alone, but intelligible and attractive to everyone of ordinary education. Of his "Dialogues" it is said "It would be difficult to find in any language a book in which animation and elegance of style are so happily combined with strength and clearness of scientific exposition."

"The service which he rendered to real knowledge is to be estimated, not only from the truths which he discovered, but from the errors which he detected and from the pernicious idols which he overthrew."

"He was never satisfied until he made a subject as clear to his pupils as it was to himself.

"His demeanor was modest and unassuming; he neither depreciated nor envied the talents of other men, but gave to all their due, and more than their due."

He was very fond of the country. He was wont to say that the city was a prison, that in the country alone was the book of nature open to him who cares to read and learn from it. Gardenening was his favorite and almost only relaxation. He was wont to say that the principal doors into the garden of natural philosophy were observation and experiment, which could be opened with the keys of our senses.

Galileo's house still remains. It is to be found at Arcetri, about a mile southeast of Florence, near the convent of St Matthew where his favorite daughter, Marie Celeste, was a nun.

"In 1864," says Fahie, "the tercentenary of Galileo's birth was celebrated at Pisa (and later at Padua) in a way which, if the news could have reached him, would have gone far to make amends for her ill-treatment in the flesh of her most famous graduate and professor."

Truth awhile upon the scaffold, but at length upon the throne.

It stills remains for us to establish wrong forever on the scaffold, truth forever on the throne.

"Oh, for a Galileo of the mind
To pierce this inner night
And deeper than our deepest dreams to find
The light beyond our light."

ALFRED NOYES.

Our Mineral Resources and Their Conservation*

EDWIN LUDLOW, Consulting Mining Engineer.

Conservation has become a hackneyed term and a very much abused one. Some years ago a certain clique connected closely with the Government in Washington became almost rabid on the subject, and their ideas of conservation, if carried out, would have prevented the development and use of our natural resources. This was espeically true in regard to the utilization of water powers, and a bill was passed through Congress which practically prevented the use of the natural water powers of this country. Fortunately this bill has sir ᵇeen repealed and the water powers are now thrown open to development under proper restrictions.

The prevention of the utilization of water power, instead of being a conservation was directly the reverse. There is no loss to the natural resources of the country through utilizing the flow of a river. That flow is not exhausted by the water being transformed into electric power and the use of that power saves the destruction of an equivalent amount of coal or wood in the generating of the power produced.

Similar restrictions were made in regard to conservation of timber. True conservation of timber does not mean allowing the trees to mature and decay, but the proper foresting, cutting out the mature timber and giving the young growth sunlight, air and proper protection from fire. No economic advantage is obtained in allowing any natural resource to go beyond its max-

* Paper read before the Elementary Science and Biology Sections of the New Jersey Science Teachers' Association at the joint meeting held on Nov. 13, 1920, at Elizabeth, N. J.

imum point of efficiency when it can be used for the public benefit.

In regard to the mineral of our country, the conservation engineers have had very little to say. The American mining methods have been superior to those of any other country, and American mining engineers have been called to operate mines in all parts of the world and have been able to produce economic results that previously had proved failures under other methods of management.

The true conservation of any mineral is the complete extraction of that mineral as it is mined, leaving no waste either in the ground or in the refuse dumps after the ore has been milled and, in all of this work, American methods have led the world. By applying American methods, such as flotation and cyaniding, the old waste dumps at mines have been made valuable producers.

We have also been in this country the great pioneers in mining through stripping off the surface. No other country has developed the large steam shovels or been able to do the efficient work that has been accomplished by American engineers in this regard and with the stripping of the surface the mining of the ore body then becomes a complete extraction of the entire ore seam.

An interesting development of the stripping methods has been brought out in the re-working at the present time of King Solomon's mine, generally known as the Rio Tinto Mine of Spain. These mines were large producers, of which we have records as far back as 440 B. C. and it was from these mines that King Solomon obtained the gold, silver, copper and other metals that made his reign so distinguished. At the present time American engineers, with American stripping methods are taking off the surface and re-working the pillars left in the mines back in the times from King Solomon on to the Roman Conquest.

An American engineer who visited the Rio Tinto mines a few years ago told me he was in the habit of going out at noon when the large blasts were being set off to loosen up the surface material so it could be loaded and transported away, as these blasts very often opened up old mining chambers that had been closed down for hundreds of years and on one of these occasions he was able to be the first man to enter an old chamber that had evidently been worked by the Romans probably at the time when this mine was attacked by the Goths and the surface works destroyed and the mine closed.

The tools that were found in this chamber indicated the period at which the work had previously been done and in the centre was found a small pile of the richer ore that the old Roman miners were taking out for the primitive smelting that they were able to do at that time. No one had apparently visited that section of the mine since that period and it was only brought to light through these American stripping methods, which is now working for the complete extraction of the entire vein, and this is real and true conservation.

In the oil industry there was at the beginning of it, and in the great rush of putting down wells, a great deal of waste, but oil has since become too valuable, and now before a well is brought in, the casing is carefully put down and anchored and all arrangements made with a valve at the top, so that the moment the oil is cut, the valve can be closed and there will be no loss of oil. Occasionally a broken valve will permit a well to run away, but all possible precautions are taken to prevent any such accident, and the old days of wasteful, careless drilling have gone by, and we can consider that the conservation methods of allowing no waste are being practiced pretty thoroughly in the oil region.

The demand for gas and gasoline has become so great that gas wells that were formerly allowed to burn up in the air are now all connected to pumping plants and pumped through pipes for hundreds of miles to furnish light and power to adjoining towns. They also have arranged on the top of many of these wells a device by which they crack the gas as it is called and obtain in that way a grade of gasoline known as well head, which helps very largely to supplement the gasoline supply obtained through the ordinary refining processes.

When we come to the subject of coal, we find, however, that the conservation methods have not been practiced to the same extent. There is still an enormous waste in coal and this waste may be sub-divided into three distinct classes:

First: The waste in mining.

While the best class of mines working under the most modern conditions are now able to show an extraction of between 85 and 90%, it was only a few years ago that 50% was all that could be estimated as the amount to be taken out of a vein and there are many mines still working under the old plans and taking only from 50 to 60% of the total extraction, leaving 40 to 50%

of coal that can hardly ever be reached on account of the squeezes and falls of roof, making the amount of rock necessary to remove to obtain this balance of coal so costly as to render the proposition entirely un-remunerative.

Another very fertile source of loss in coal mining is the working of parallel veins separated by 40 to 100 feet of strata, in which the operator would go first into the vein that was thickest, producing the cheapest coal, irrespective of the fact that in the mining of this coal he was destroying the next vein above as the separating strata was so light that the roof falling in the vein he was working would break through in the vein above and render it almost impossible ever to mine this thinner vein above.

They plan much better than this in Europe, and as an example, I cite my own experience in northern France, prior to the Great War when I was visiting the coal fields there that were later destroyed by the Germans, and went with the chief engineer of a large French coal company to see a new plant he was just completing. The workmanship at this plant was the best I had ever seen. The buildings, steel tower, the hoisting engines were all not only of the very latest construction and absolutely fire-proof, but were built with an architectural taste that is sadly lacking at our own coal mines.

In looking out over the plain where this shaft was located I noticed shaft heads and tipples at what appeared to be rather close proximity and I asked the chief engineer how it was possible to spend so large an amount of money on a plant of this kind that had apparently such a limited acreage to draw from. He told me that the first vein they would reach with that shaft would be 1200 feet, and from that point to 2500 feet, they know from their drill records, they would be passing through a series of veins of various thicknesses. The first vein would be worked and no work done in the vein below until the long wall workings in this first vein had not only progressed to a sufficient distance around the shaft but that the roof had taken its weight, as it is called, on the long wall packing, so that the work in the next vein could be started without any danger of breaking through into the vein above.

These veins were each of them worked out with 100% extraction on the long wall system, irrespective of thickness, being taken in the order as they were reached, and the life of the shaft would probably be about 100 years. It was therefore ne-

cessary to make the installation not only up-to-date but as far in advance of the date as possible, so that it would not become obsolete before the coal was extracted.

The second method by which conservation should be practiced is the utilization of all the coal produced from a mine. In some mines that I have visited, as much as 18 inches of good coal has been left to form an artificial roof, as the coal was harder than the slate above it, and it was more economical to leave this coal in, than to take it down and timber under the slate roof. At other mines there are large bodies of boney, which is an impure form of coal, running high in ash. While this coal is too impure to ship, it is capable of producing a great deal of steam and could be economically utilized if burned in a power plant near the mine, transforming the refuse in this way into electric power which could be transmitted where needed.

The third form of conservation, and one that should be more generally impressed upon the public at large is the great loss of coal in the wasteful methods by which it is burned under boilers. Coal has been so cheap in this country and so plentiful that very little thought has been given to getting the full efficiency out of every pound of coal fired.

As an example of this, I can cite an experience I had in visiting quite a large plant where I had been making some tests. The president of the Company told me with great pride that he always insisted upon buying coal of not less than 15000 B T U'S. I told him that was extremely good economy provided he got the 15000 B T U'S out of the coal when he burned it, but, as a matter of fact, my tests showed he was only obtaining 11000 B T U'S and, by improving his plant he could either obtain the same amount of steam through the use of an inferior coal or by using less of the good grade.

The economy of the transforming of steam power into electric power has been brought out in Mr. Murray's previous address* and we are just on the threshhold of the work that can be done in that regard No one thing would do so much towards the conservation of our coal resources as a campaign to increase the use of electric power in our factories, and especially on our railroads. There is no more wasteful type of boiler than the boiler of a locomotive, and 30% of the entire output of the bituminous mines of this country is burned by the railroads. The electri-

* For the gist of this address see pages 30-31, "Literary Digest", Nov. 13, 1920.

fication of the railroads would cut that consumption at least in half, and would cut the consumption at the manufacturing plants that purchase electricity to one-fourth. But, the electricity must be generated in large central plants equipped with the best type of boilers and handled by experts. Coal can be wasted in small electric plants just as well as in the manufacturing plants.

It would not be necessary, however, to produce all of this electricity by steam as our water power reserves have not been fully developed, and feeder lines from hydro-electric plants that could be established would still further reduce the coal consumption.

In the anthracite region, conservation has got to be practiced for the reason that the anthracite tonnage has been at its maximum for the last five years, and in spite of the efforts that were made during the war to increase the output, the only increase that was made was in the re-working of the old culm banks and the obtaining of such coal as could be saved from the refuse put out in many cases thirty and forty years ago when the methods of preparation were not so efficient as they are to-day.

The consumption of anthracite is steadily increasing as our population increases and the only way that this increase can be met is by the utilization of the finer sizes, which formerly only had a market for steam in competition with bituminous coal. Special heaters are now being made in which these smaller sizes can be burned in houses with the result of obtaining practically the same amount of heat per ton at a lower first cost and less attendance.

Briquetting of the anthracite slush which is now being wasted at the rate of over a million tons a year is also growing in favor and these briquettes will be a constanly increasing factor in supplying the domestic sizes of anthracite. The slush from which these briquettes are made is the very fine coal, passing through a 1-16 inch mesh, being the smallest size over which the No. 3 Buckwheat is now being screened. This fine slush travels with the water that is used in the washing of the coal and the operation of the jigs in the preparation of anthracite, and is then pumped up into storage dams where the coal settles and the clearer water passes off and is used over again. These slush dams will ultimately have a value as the briquetting of anthracite is increased.

The realization of the necessity of conservation is very strong in the anthracite region, and extreme care is used to see that the refuse going out from the breaker does not carry any appreciable amount of good coal. It was poor preparation that made the greatest loss in the earlier days, but the methods and machines have been improved so that the present Culm Banks are too lean in coal to make the re-working of them profitable.

The methods of mining are also being constantly improved to increase the percentage of extraction, and every effort is being made to recover coal wasted in former days, even to the extent of dredging the rivers leading through the anthracite region and separating the coal from the refuse that has been carried down in previous years.

Many parts of the bituminous fields have now reached the stage where the best coal has been mined and it becomes necessary to work thinner seams or inferior beds. More careful methods of preparation are going into effect in the bituminous region to make salable these inferior grades that could not be marketed formerly.

One of the greatest improvements coming to this country and coming only too slowly is the transforming of the making of coke from the old-fashioned beehive oven that was thrown out of Europe thirty years ago as too extravagant, and the making of the coke in the modern by-product ovens, which recovers all those extremely valuable by-products which are more valuable than the coke itself; and in many instances the coke becomes the by-product and the profits from the ovens come from the sulphate of ammonia, tar and the refined coal tar by-products that are obtained.

There is enough gas going to waste from the beehive ovens along the lines of the Pennsylvania Railroad, between Pittsburgh and Altoona to furnish the power for that entire division. In Pittsburgh itself, however, there is growing up a tremendous industry in the by-products ovens. A large portion of the Pittsburgh seam is especially adapted to the making of by-product coke, yielding not only a good metallurgical coke for the blast furnaces, but also very rich by-products. This seam has grown in value until at the present time it can not be bought for less than $10,000.00 an acre, and, when one considers that $100.00 an acre is an extremely good price for

ordinary bituminous coal land, one can appreciate the extreme value of this special grade of by-product coal.

In order to be able to obtain a continuous supply of this coal to keep up the supply for their ovens, irrespective of the fluctuation in car supplies, which has interfered very seriously in the steady operation of the ordinary mines, they have arranged a line of barges on the Monongahela River and with an ice-breaker, that keeps the river open at all times of the year, they have concentrated this coal at loading tipples on the river and, in order to be entirely independent of railroad or surface transportation, the mines have been equipped with eleven miles of under-ground haulage way so that, no matter what interruptions there may be in the surface transportation or the operation of the railroads, this coal can always be brought out, dumped into barges, and the coke ovens fed their daily allowance of the best grade of this Pittsburgh coal.

This is a condition that will probably be developed more and more with the building up of the water transportation to assist the railroads in the handling of large quantities of bituminous coals. The ordinary car supply at the majority of mines of this country is not over 50%. This means that the miners are only working half the time; it means that the plant is idle half the time while fixed charges for maintenance ventilation and supervision are going on at full time. All this not only adds to the cost of producing coal but limits the supply for the public, and has been the great factor in the shortage of coal for the last three years.

The railroads have made a strong fight against the use of the rivers and canals for the transportation of coal, putting down their rates wherever this competition cropped up, to a point that made it unprofitable to use the slower river transportation. The recent advances that have been made in the freight rates, that will probably not be taken off, have again opened up this river competition, and the Ohio and Kanawha Rivers will in another year show their old-time activity in the fleets of coal barges passing down to supply the cities that can be reached by this water transportation.

The Government has done a great deal of good work in making possible this river transportation in such rivers as the Kanawha and the Upper Ohio. If the same work could be done on the Delaware River it would be of enormous assistance

in supplying water transportation for a large amount of the anthracite coal. And our increasing population and great cost of terminal facilities make it necessary that we conserve the amount of freight our railroads have to carry if they are to handle the continually increasing load that the increasing population of the cities is forcing upon them.

In this connection, I should like to bring to your attention how Newark meadows could be utilized not only to permit a more regular operation of the coal mines, but also to prevent the periodical fits of nervousness of our public utility companies over threatened shortages of their fuel supply.

Under normal conditions the bituminous mines are faced with two great obstacles to steady work—a lack of orders for the coal in summer, and the deficient car supply in winter. If larger storage areas on the meadows could be filled with coal in summer, there would always be a supply to draw from in the winter, and the coal could then be given to the householders without crippling any of the essential industries in the vicinity of New York.

The meadows are ideally located, as practically all the coal-carrying roads pass over them, and water transportation could also be utilized, not only to receive coal, but also to distribute it to Manhattan Island and Brooklyn.

The question of spontaneous combustion or loss in efficiency in stored coal could also be met by making this storage under water in dredged basins, equipped with proper machinery for unloading and reloading—such basins being connected with the harbor by deep water channels for the barges bringing or taking out the coal.

The storage of bituminous coal under water is not an experiment, but has been proved a success wherever tried; and such a plant would be a long step in conserving our coal supplies, as the number of operating mines now needed to produce the 550 million tons this country requires could be reduced by at least one third, and 100,000 miners released for other work.

Echoes from The Conference on The Science Bulletin

The bulletin on Reorganization of Science in Secondary Schools prepared by the N. E. A. Committee was under discussion at the Massachusetts State Conference of High School Principals at a meeting held at Harvard University on March 25, 1921. Several hundred principals, science teachers and superintendents were present.

Dr. Caldwell, Director of Lincoln School of Teachers College, New York and Chairman of Science Committee in a one hour address, presented in a most entertaining manner the salient points of the report.

After a short intermission, the following men discussed the report: Palmer of Newton, Wood of Cambridge, Warner of Springfield, Andrews of Worcester, Page of West Newbury, Packard of Brookline, Black of Roxbury and Whitman of Salem.

The predominating tone of the discussion was very favorable to the report. Adversely, the report was criticised in not giving sufficient consideration to college preparation; to some, the physics report was not satisfactory; particular objection being made to the first two pages and also to the lack of emphasis on mathamatical physics.

The teacher who complained of lack of mathamatical physics stated that physics had come to mean mathamatics to him and that there could be no physics worth while without mathamatical treatment.

The subject of "General Science" also came in for a knock. One speaker criticized it because of its lack of definiteness and lack of agreement about the contents. He said he knew there were at least twenty different courses in general science because he had taught it for twenty years and had taught it differently each year. He claimed to be a physicist and chemist but volunteered he knew absolutely nothing about biological science. He predicts that general science will soon go out of use. We would like to suggest, first, that in our opinion a teacher who has no preparation or interest in biological science has no business to attempt to teach general science and, second, that calling an elementary course in physical science, "general science," does not make it *general science*.

Botulism[1]

By PAUL F. ORR, Department of Preventive Medicine and Hygiene, Harvard Medical School, Boston.

HISTORICAL

The earliest reports regarding botulism, or sausage poisoning, were made in the German literature during the middle of the eighteenth century. The frequency with which these cases occurred resulted not only in frequent reference to the subject in the literature, but also official warnings were sent out regarding the danger from eating spoiled sausages, and in some places laws were passed requiring the registration of cases of sausage poisoning. Mayer has summarized the incidents of botulism and food poisoning in Germany during the past one hundred and thirty years. About 1,200 cases have occured during this period of which about 360 were fatal, giving a mortality rate of 30 per cent. The reports published during the past few years indicate that botulism is still quite frequent in Germany and Austria. Occasional cases have been reported in France, Holland, Denmark and Belgium, but the disease is quite rare in these countries.

According to Savage no authentic cases of botulism have occured in Great Britain. The recent outbreak of so-called "epidemic botulism" in England is now considered to have been encephalitis, and in no way conected with botulism.

Some recent Russian publications report that in that country "fish poisoning" has been quite prevalent. The striking similarity of these cases to those of botulism is suggestive of the fact that the fish poisoning with which they are dealing is in reality a type of botulism.

The work of Wilbur and Ophuls in 1914 was mainly responsible for bringing botulism to the attention of the medical profession in the United States. Previous to this time only a very few cases had been reported in this country. Since 1914, however, the reports of Dickson, Shippen, Graham, Burke and others have shown that botulism occasionally occurs in the United States, and that it is one of the problems requiring the attention of public health officials. Recently it has been given disproportionate importance compared with major problems, such as tuberculosis, venereal diseases, etc.

ETIOLOGY.

Bacillus botulinus, the causative factor of botulism, was

1 From Vol. 7, No. 3, "The Commonhealth."

discovered by van Ermengem in 1896, in connection with a food poisoning outbreak at Ellezelles, Belgium. The organism is a large Gram positive, motile rod, which produces spores. It is a strict anaerobe, however, when grown in symbiosis with certain aerobic bacteria it may develop in the presence of air. *B botulinus* is a strongly proteolytic organism. Protein substances on which it is growing are digested and a strong putrefactive odor is given off. Gas which is usually produced is due to the presence of glucose or other fermentable sugars.

HABITAT.

Until the recent work of Graham and of Burke practically nothing was known regarding the habitat of *B. botulinus*. Graham has encountered this organism in a relatively large number of animal feeds, including ensilage, oat hay, corn fodder and bran. These feeds came mainly from Kentucky and Illinois.

In examining 235 cultures made from samples collected in different parts of California, Burke demonstrated the presence of *B. botulinus* in several of these. Bruised and mouldy cherries, beans, spiders and moldy hay were some of the sources from which *B. botulinus* was isolated. From the work of Graham and Burke, and from the frequency with which recent outbreaks of botulism have occurred, it seems quite probable that *B. botulinus* is widely distributed throughout the United States.

FOODS INFECTED

Botulism has been generally recognized as resulting from the ingestion of spoiled sausages. In fact, up till the time of the Darmstadt outbreak, in 1904, meat of some sort was considered necessary for the growth of *B. botulinus*, but in this outbreak a vegetable medium (beans) was the origin of the toxin.

I have found that *B. botulinus* grows readily and produces very strong toxin in canned peas, corn, baked beans, string beans, carrots, hominy and asparagus, besides the various meats.

Dickson states that he has obtained growth and toxin production in various fruits in which he had neutralized the acid. However, is rather doubtful that *B. botulinus* will grow and produce toxin in the different fruits as ordinarily canned on account of this acidity. It is true that a few outbreaks of botulism have occurred in which spoiled fruits were considered to be the cause. However, in each of these cases there was a divergence of opinion as to the food at fault.

Ripe olives have occasionally proven to be a medium for the growth of *B. botulinus*. However, ripe olives, as usually

bottled, I have found to be about neutral in reaction, which is favorable for the growth of this organism. Most of the other fruits as ordinarily canned have rather a high acidity, in fact, much greater than what I have found is necessary to prevent the growth of *B. botulinus*. The high acidity of green olives, obtained ordinarily on the market in bottles, makes it appear quite improbable that any cases of botulism will result from the ingestion of these olives. In one instance in this country an outbreak of botulism was traced to the consumption of homemade cottage cheese.

BOTULINUS TOXIN

B. botulinus produces a very powerful poison. As has been stated, it may develop in many of the common food materials. Instances have been reported in which merely tasting the spoiled food resulted fatally.

The toxin standing at room temperature in the dark deteriorates very slowly. Infected beans I have found to be very potent after standing for more than a year under these conditions. A temperature of 80 degrees C. for from five to ten minutes definitely destroys the toxin. Any food material which has been heated to the boiling point may be considered to be free of toxin. However, it should be kept in mind that this temperature may not destroy all the spores of *B. botulinus* which may be present; hence, if the food material is allowed to stand at room temperature for twenty-four hours or more after heating, more toxin may be produced, and thus the food may again become poisonous.

A brine of 8 per cent or greater has been found to prevent the growth of *B. botulinus,* so food materials which are carefully preserved in a brine containing 8 per cent of salt or more may be considered safe from the standpoint of botulism. From the results which have been obtained it appears that sugar has comparatively little effect in inhibiting the growth of *B. botulinus*. A syrup containing at least 50 per cent of glucose has been found necessary to inhibit growth.

BOTULINUS ANTITOXIN

Antitoxin has been prepared against botulinus toxin, and if used in time will protect against fatal doses of the toxin. The practical value of this antitoxin is rather limited due to the fact that by the time the diagnosis of botulism is made the intoxication has proceeded to such an extent that the administration of antitoxin has little if any beneficial value. Like tetanus and

diphtheria antitoxin, it must be given early to exert its maximum beneficial effects.

CHANGES PRODUCED IN FOODS

As a general rule, foods in which *B. botulinus* has developed are distinctly spoiled. There may be only a slightly rancid odor, or it may be distinctly putrefactive. Foods showing evidences of gas formation should be considered unfit for food. *B. botulinus* produces gas in practically all foods in which it grows. As has been stated, this organism is distinctly proteolytic in character, consequently, any food materials in which it develops will tend to become soft and mushy.

Foods having an abnormal odor, showing evidences of gas formation, and which are soft and mushy in character, should be considered dangerous, and under no circumstances be served for consumption. They should be thoroughly cooked and then thrown in the garbage pail. Occasionally foods may contain enough toxin to be dangerous, while at the same time there may be only very slight evidences of spoilage. Tasting of these suspicious foods may be hazardous; instead, they should be boiled for about five minutes, after which even a very slight decomposition of the food can be easily detected by the odor.

PREVENTION OF BOTULISM

Recent work has shown that the spores of some strains of *B. botulinus* are very resistant to heat, some requiring exposure to a boiling temperature for about four hours before being entirely destroyed.

The usual methods of home canning are inadequate, from the standpoint of both temperature and time of heating, to insure the destruction of the spores of *B. botulinus* in every instance. The safest method is to process foods with steam under pressure so that they are heated to 120 degrees C. for ten minutes or longer, according to the best commercial practice.

The use of fresh, sound fruits, vegetables and other foods, as well as extreme care and cleanliness in the preparation of these foods, will aid greatly in the prevention of botulism. Thorough cooking of foods just before being served is also an important safeguard.

A great deal of valuable information of epidemiological and etiological significance could be obtained if botulism would be made a reportable disease. This has been done by both the States of California and Oregon. Even as early as the beginning of the nineteenth century, sausage poisoning, or botulism, was made a reportable disease in the kingdom of Wurtemberg.

Aspirin

Some ten years ago the editor remembers attending a meeting of chemistry teachers at which a member of the Harvard Medical Faculty spoke upon the "drug habit." After he had finished that part of his talk in which he condemned the headache remedies commonly found on sale, he was asked if there was any remedy which one could safely use. He replied that *aspirin* is a harmless remedy.

In recent years aspirin has come to be very commonly used not only for head-aches but for other ailments as well and so frequently are cautions given against its use that some authoritative statement about it is desirable. An inquiry was recently sent to the American Medical Society of Chicago and the following note was received from Arthur J. Cramp, M. D.

"As to aspirin: The indiscriminate use of this drug that has been prevalent for the last few years is a distinct menace to the public health. Aspirin does not properly belong in a legitimate list of remedies for self-treatment. The promiscuous use of this substance has frequently led to cases of rather severe poisoning, the chief symptoms being a swelling of the lips, tongue, eyelids, nose or of the entire face. In some cases there has been a skin rash; in others dizziness and nausea and sometimes a blueness of the skin. Some persons are especially susceptible to the action of aspirin.

"No discussion of aspirin is complete that does not call attention to the misleading advertising campaign apparently designed to make the public believe that the only real aspirin is made by a certain firm. The facts are, of course,aspirin is aspirin just as quinin is quinin and one reputable firm's aspirin is just as good as another's. It is true swindlers have put out inert material or even other drugs under the name of aspirin. It is equally true that swindlers have also put out similar sophisticated mixtures under the name of other well-known drugs."

Lighting Definitions

Intensity of Illumination is the term used to express the quantity of light falling on a surface. It is expressed in foot-candles or lumens per square foot.

Diffusion is a quality of light resulting from an irregular arrangement of light rays which produces soft shadows and minimizes glare.

Glare is a quality of light usually resulting from excessive brilliancy or contrasts which reduces ability to see and causes discomfort or eye-strain.

"It is often said that the enormous fire loss of the United States, with its terrible destruction of life and property, is largely preventable. If each of the school children in the United States would learn how to prevent fire and would form habits of carefulness and consideration it would go far in saving lives and property."

HON. P. P. CLAXTON,
United States Commissioner of Education

The Trial of Fire[1]

SCENE: COURT ROOM

There should be a large chair and table for the Judge's bench if nothing more accurate is available. There should also be a chair and table for the Clerk of the Court, a witness chair beside the Judge's bench and chairs for the twelve jurymen and spectators. Various pupils should be designated to represent the different fire hazards.

The use of special costumes is optional. These may easily be constructed of cardboard, cloth or otherwise. However, it will answer every purpose to hang placards about the necks of the pupils.

DRAMATIS PERSONAE

The Judge	Court Officer	District Attorney
The Jury	Clerk of Court	Counsel for the defense

The Defendants

(Eleven of the Major Causes of Fire)

Kerosene	Electricity	Defective	Lightning
Cigarette	Rubbish	Chimney	Bonfire
Match	Gas	Gasoline	Spontaneous

The Arch Criminal: Carelessness. Combustion

1 From "Safeguarding America Against Fire", Vol. 3, No. 9.

The Judge enters after all have assembled. The different defendants (the hazards) are led in by the Court Officer. Everybody stands as the Judge enters.

Clerk (standing): Oyez, Oyez. All ye who have business with this honorable court draw near and present your petitions. (No one moves.) (He continues): The first case on the docket is that of The People vs. Fire.

Judge: I assume that the formalities have been observed.

Clerk: Yes, your Honor.

Judge: Are the Counsel ready for trial?

District Attorney: The People are ready, your Honor; the defendants should have been brought to trial years ago.

Judge: Who is appearing for the defense?

Counsel for the Defense (rising): I am, your Honor. I wish to say that there are eleven defendants involved in this action. Each defendant will speak for himself.

Judge: Very well. We will proceed. (Looks at paper.) I see that Kerosene is charged with having willfully caused the death of a little girl and boy and the destruction of their home. Clerk, call the defendant.

Clerk (calling): Kerosene to the bar.

Judge: Kerosene, you have heard the charge, what is your plea?

Kerosewe: Not guilty.

Judge: Have you any witnesses?

Kerosewe: I am my own witness.

Judge: Clerk, swear the witness.

Clerk: Do you solemnly swear that you will speak the truth, the whole truth, and nothing but the truth, so help you God?

Kerosene: I do.

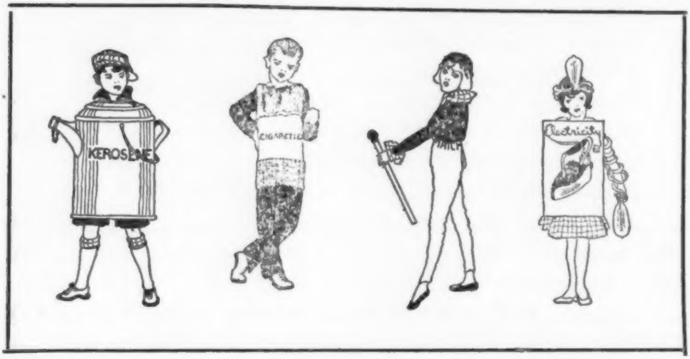
Judge: What have you to say for yourself?

Kerosene: May I tell how it happened in my own way?

Judge: Yes, go on.

Kerosene: I was enclosed in my usual container, your Honor, waiting to be of service and doing no one any harm, when the little girl came into the kitchen, took me up and poured me into the kitchen stove because she thought the fire was not burning fast enough. It was not my fault, your Honor, that I was kept in the kitchen where I had no business to be; it was not my

fault that the child was allowed to handle me and I could not help myself when I touched the flame; I flashed back, of course, exploding the can and burned the little girl to death. I also burned her brother who was playing nearby on the floor. There would have been no fire, your Honor, if the family had been careful and the children had not been allowed to play with fire.



Judge: I recognize the truth of your story, Kerosene, and dismiss the case against you. (Kerosene takes seat at one side.)

Judge: What is the next case?

Clerk: It is all part of the same case, your Honor; the next defendant is Cigarette.

Judge: If there are many more defendants in this case swear them in at once.

Clerk (turning to pupils representing hazards): Do you solemnly swear, that you will speak the truth, the whole truth, and nothing but the truth, so help you God?

Chorus: We do.

Clerk: Cigarette to the bar.

(Cigarette comes forward.)

Judge: Tell us just what happened.

Cigarette: I was in a man's pocket in a warehouse, your Honor, where a dangerous chemical was being stored. The man knew it was against the rules to smoke me, but he was reckless and took a chance. When I was almost consumed he threw me on the floor and this ignited some of the chemical scattered about and caused it to explode the entire storage. The damage amounted to $2,000,000, but it was not my fault. I cause fires only when used by careless people.

Judge: Step down until we hear some of the other defendants.

Clerk: Is Match present?

(Match steps forward, takes the witness chair.)

Match: Somebody threw me on the floor, your Honor, and a little child found me and used me in play, for she did not know that I was dangerous. First she ignited the curtain at the window and then her own clothing. They took her to the hospital and she may recover, but if she does, she will be disfigured for life. I was not guilty of any wrong doing and the accident would not have occurred if I had been kept out of the reach of small children.

Judge: Take your seat until we hear the rest of the witnesses. Call the next one, Clerk.

Clerk: Electricity, take the witness chair.

Judge: Your record is a bad one, Electricity. You started out in life with great opportunities for service, but you seem to have "gone wrong" until you have become the chief cause of fire in the United States. Every year you destroy millions of dollars' worth of property. What is the reason.

Electricity: Your Honor, I have been basely used. I possess tremendous power, but nevertheless, I am harmless if properly installed and kept within bounds. I should be insulated against chance contacts and my wires should not be given too much to do. I was haled into court, your Honor, because I overheated an electric flatiron and set fire to a newly built home. I burn many other homes in the same way every day, but it is not my fault, your Honor. When I am once put to work I have to continue until I am switched off, but people forget and leave electric irons and other heating devices in contact. Consequently, these devices grow hotter and hotter until they ignite the nearest combustible material and soon there is another fire. Sometimes this occurs at night and causes loss of life, and yet engineers call me the safest known form of power and light when properly used. If people would only be careful instead of careless in using me, there would be no cause for complaint. (Electricity steps down and takes former chair.)

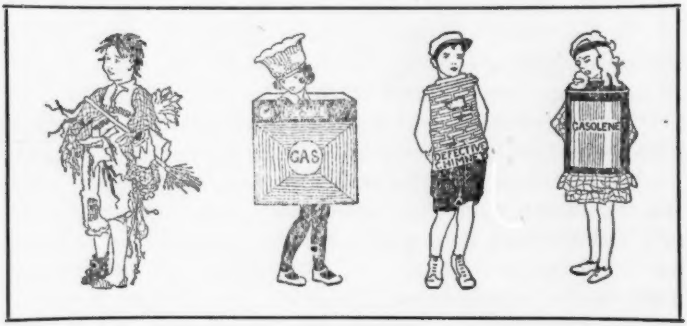
Clerk: Rubbish is among the defendants, your Honor.

Judge: Very well; call Rubbish. (Clerk beckons and Rubbish advances to the chair.)

Judge: I find that for a good many years you have been

hanging around corners and have become a thoroughly undesirable citizen.

Rubbish: I was once a man of parts, your Honor, but now I am only a part of a man. I am made up of odds and ends from here and there and have no will of my own. If people realized how dangerous I am, because I furnish fuel for the chance spark and often ignite spontaneously, they would not have me around; but I find plenty of cellars and attics to sleep in where the careless housekeepers never disturb me and I stay in where careless housekeepers never disturb me and I stay there until I catch fire. I sometimes have to wait years, but the older I am the better I burn. However, I am not at fault, your Honor, because I cannot remove myself.



Judge: You have said a good deal and it is not all rubbish. (To Clerk) Call the next defendant. (Rubbish resumes former chair.)

Clerk: Gas to the bar.

Gas: I would like to tell my story in a few words, your Honor.

Judge: Very well, proceed.

Gas: Before I came into use, your Honor, people ruined their eyesight with candle light and often killed themselves with defective oil lamps. Oil was not properly refined in those days and, therefore, thousands of lamps exploded, causing great damage to life and property. I became and still am a boon to mankind, but I am touchy, I admit, and must be handled with care. People use rubber hose connections on stoves that I am supplying, instead of installing rigid iron pipes; a break develops, I escape

into the air and cause an explosion and fire. Often a leak occurs in the cellar from poor connections or because of defective pipes and a careless mortal looks for me with a candle or other open flame. He is sure to find me, but in doing so he is apt to kill himself and burn up the property. Carefulness would prevent such occurrences. (Gas steps back to former seat.)

Judge: I believe that Defective Chimney is closely involved in fire troubles. Where is he? (Clerk beckons to Defective Chimney.)

Judge: I am given to understand that you cause a great many preventable fires.

Defective Chimney: Yes, your Honor, I do. Many contractors do not build me properly. In some places they support me upon brackets instead of building me up from the ground. Sometimes they build me only one brick in thickness, and, still worse, construct me with my bricks on edge instead of flat; consequently, I develop cracks through which sparks escape and cause fire. Frequently, the sparks fall upon the roof and when it is made of wooden shingles there is likely to be another home burned up. Sometimes the cracks are under the roof and the sparks fly into the attic which is a dangerous place for a fire to originate. Careful construction, your Honor, as set forth in the Standard Building Code, is the only remedy. (Defective Chimney takes former chair.)

Judge: The name of Gasoline is next.

Clerk: Yes, your Honor, I will call him. (Beckons and Gasoline takes the witness chair.)

Judge: Gasoline, you have made a place for yourself in good society and I am shocked to find that you are charged with countless fires.

Gasoline: Yes, your Honor, I am forced to admit that this is true, but it is due to the fact that the average citizen does not realize my power. I have killed many people and started thousands of fires because I am volatile and flash up upon slight provocation. Housewives sometimes use me for cleaning purposes in their homes. The moment I am free my vapor starts about the house looking for a flame or a spark. Presently I find it and, pouf! I cause a terrific explosion. Not long ago I killed a California woman because she used me to clean her silk waist. The rubbing of the silk caused a spark, which was all I needed. With automobiles in every highway and byway, nowadays, I

have become almost as common as water; yet men will smoke around filling stations and then wonder why there are accidents. I work hard for humanity, and am, your Honor, reasonably safe when properly handled. I am more dangerous than dynamite, however, when carelessly used, for it takes but a little spark to set me off.

Clerk: Lightning to the bar.

Judge (To Lightning, who has taken witness chair): We have shocking reports of your work, Lightning; you strike helpless women and children as well as grown men, and destroy their homes. Have you anything to say in defense?

Lightning: Yes, your Honor, I am created in the sky by atmospheric conditions at certain times, but I am forced by nature to seek the earth. I try to reach the ground by the easiest means. When people equip their buildings with properly installed lightning rods, I use these conductors to travel to the earth and seldom cause any damage in doing so. There are not enough houses properly protected, however, and consequently I have to do the best I can with the means available. I often try flag poles, steeples and chimneys, because they come nearer to me than other portions of buildings, but I do not like them as well because they are not such good conductors of electricity. Sometimes I even cause forest fires, but country barns are my specialty. I shall be a force to be reckoned with, your Honor, as long as the world lasts and it behooves people to protect themselves against me.

Judge: It is evident that in your case, if you spare the rod, you may spoil the property. Clerk call the next defendant.

Clerk: Bonfire is next. (Bonfire steps forward and takes the witness chair.)

Judge: The records show, Bonfire, that while you have always been popular with children you have acted toward them treacherously, harming them and sometimes destroying their homes as well. Is this true?

Bonfire: Grown people as well as youngsters often start me, your Honor, and by doing so they frequently cause serious loss of life as well as of property. I am always potentially dangerous and seldom necessary, except to destroy rubbish, but when I am, I should be confined so that I cannot scatter sparks. A bucket of water or some other extinguisher should be at hand to keep me within bounds. There was a man in Alabama who forgot my possibilities, and one day, when there was a high wind, lighted me in order to burn up some old chicken coops and trash. There was a wooden fence nearby as well as a frame garage, and before I got through 191 buildings were destroyed. Nevertheless, I plead not guilty, your Honor, because I do not start fires unless some careless person starts *me*. (Resumes former seat.)

Clerk: There is one more defendant, your Honor, Spontaneous Combustion. (Spontaneous Combustion takes the witness chair.)

Clerk: You were sworn with the others?

Spontaneous Combustion: Yes, sir.

Judge: Proceed.

Spontaneous Combustion: Many people, your Honor, think that I am a myth; the Peter Pan of fire causes, but I want you to know that I am a self-starter when conditions are propitious. People allow old rags saturated with linseed oil or some other vegetable fat to accumulate in out-of-the-way corners, and the first thing they know I generate sufficient heat by chemical action to start a fire. I also ignite piles of rubbish where there is oily matter present and all who store large quantities of coal, particularly if it is bituminous, should beware of me. I cost the country last year about $10,000,000 in property that I destroyed and yet some people doubt my existence.

Judge: Do you plead guilty?

Spontaneous Combustion: No, your Honor, I plead not guilty, for how can I help myself? Chemistry is my master and careless human beings are the chief reasons for my existence.

Judge: You may resume your seat. (He does so.) (Turns to Clerk.) Are there any more defendants?

Clerk: No, your Honor, none that we have yet been able to locate.

Judge (turning to District Attorney): The prosecution may sum up.

District Attorney: Gentlemen of the Jury, you have heard these various defendants testify in their own behalf. They have acknowledged their connection with various specific crimes. They also have admitted that they were concerned in thousands of terrible disasters. They have shown no penitence and have expressed no intention of changing their destructive habits. These fire hazards, gentlemen, have convicted themselves by their own testimony. They have shown how dangerous they are and if they continue at large the very progress of the United States may be jeopardized. We cannot continue to burn up our natural resources at the present rate without courting disaster. I believe, gentlemen, that when you consider the evidence you can do no less than convict these defendants as constituting a menace to our country. Their only rightful place is under lock and key. (Resumes seat.)

Judge: The Counsel for the Defense may now put in his rebuttal.

Counsel: I move, your Honor, that this case be thrown out of court on the ground that proof of guilt on the part of the defendants has not been established. These defendants, your Honor, are for the most part tools—involuntary tools of man. When rightly used they render him great service, for they are mighty, but the power to serve is generally accompanied by the power to harm. I maintain that the testimony of each of these defendants shows complete absence of intent. They act as they have always acted and as they always *will* act under such conditions.

Man understands their nature; when he gives them their opportunities he knows, if he will stop to think, what the result must be. Therefore, why blame them for what they cannot help? Why not bring to trial the real culprit, Carelessness, who alone is responsible for most of our fires? Why not bring before the bar of this court the guilty one who causes these defendants to work havoc throughout the land? Without his evil influences they would merely be servants of humanity.

Judge: The court is of the opinion that the point is well taken. Carelessness should be the defendant here and not these prisoners. Where is Carelessness, Mr. District Attorney? This

court is of the opinion that you have been remiss in your duty in overlooking the arch criminal who causes the majority of all fires. (Court officer walks over and hands a note to the District Attorney.)

District Attorney: Your Honor, I have been looking for Carelessness and I have just received word that he has been brought to court and is now in the ante-room.

Judge: Have him brought in. (Carelessness, represented by a pupil in patched, dilapidated clothing, is hustled in roughly by the court officer who leads him before the Judge.)

Judge: The testimony that has been given in this court in the case of The People vs. Fire has indicated that you, Carelessness, are the culprit who should have been brought before the bar of justice. You are charged with having caused the loss of thousands of lives and the destruction of millions of dollars' worth of property every year. What have you to say in defense?

Carelessness: Nothing, your Honor, except that I am an ingrained habit of the American people. I begin with the youngest children and stay with them throughout their lives. Other countries do not encourage me to any great extent, but I seem to be welcome in every city, town and village of the United States, by young and old and rich and poor alike. I recognize danger, but I like to "take a chance."

Judge: That is an explanation, but not an excuse. I charge the Jury, on the evidence of these defendants and on his own admission to find Carelessness guilty in the first degree.

(The Jury consult their seats, the Foreman rises.)

Foreman: We find him guilty, your Honor.

Judge: You have heard the verdict. It is now my duty to sentence you in accordance with the dictates of justice. There can be no doubt as to your guilt. You have made it impossible for citizens and municipalities to live safely. You have killed thousands and devastated whole cities by your iniquity. You have filled the land with misery. You have undermined character, lowered efficiency and retarded progress. Incarceration is too good for such as you. Instead you shall be labeled so that all men shall know you and shall shun your presence. You shall be an exile—a man without a country—unless some Nation is so short-sighted as to take you in and call you her own. America banishes you forever. Officer, take him away. (Officer exists with prisoner.)

Judge:..The court is adjourned.

(Curtain)

The Potato: A Class Project

By Senior III, Boston Normal School, under the direction of Miss Gertrude Weeks.

The project method is discussed so frequently in educational work to-day that we members of Senior 3 of the Boston Normal School, wished to understand it thoroughly. We analyzed its definitions and fundamental ideas but reached the conclusion that the best way of learning was by doing; therefore we decided to work out a class project on the potato. Each member of the section proposed questions about the potato which she would like to have answered. These, after careful study, we presented to the class. Through this method of procedure every girl had her own interesting project-problem and when we had concluded the work we agreed with and really understood Mr. Kilpatrick's definition of a project. "A whole-hearted, purposeful activity proceeding in a social environment." The project-problems presented in class are given below in practically the same order as we gave them.

Gertrude Schnurr.

Problem 1. *What is the history of the potato?*

Subject Matter. The potato is a native of the mountainous districts of tropical and sub-tropical America, from Chili to Mexico, a form occurring as far north as Southern Colorado. First brought to Europe by a Spanish monk in the 16th century, it spread from Spain to Belgium and Southern France, but only to be cultivated as a curiosity. It was brought to Ireland from Virginia by Hawkins in 1565; and to England by Sir Francis Drake in 1585. Sir Walter Raleigh is said to have taken some tubers to England in 1586, bringing them to the attention of Queen Elizabeth. He was the first to cultivate the potato in the British Isles on his estate in Ireland, near Cork. The potato was first used as food for swine and cattle and for the peasants in time of the failure of other crops, and famine. The Royal Society of London in 1663 adopted a measure for the extension of the cultivation of the potato. At the end of the 18th century it was an important field crop in France and Germany, countries which have since become two of the greatest potato producing countries of the world. In America we find a remarkable potato developed by Luther Burbank in 1873.

When he was a boy he was walking in his father's garden one day and noticed a seed-pod on one of the potato plants. He decided to plant the seeds to see what would be the result. There were 23 seeds in the pod and these were carefully preserved through the winter and planted in the following spring. The seeds were planted each in its own hill and the plants which grew were carefully cultivated. When the tubers were dug, they were found to represent 23 varieties. Two hills contained potatoes of exceptional quality. These were carefully preserved and planted. The tubers which came from them inherited the same unusual qualities. These were a potato whiter, larger, and more uniform in size than any other potato. This is the Burbank potato. His chance discovery can not be rivalled by scientists who have performed hybridizing experiments for forty years.

Mary Doherty.

Problem 2. *What part of the plant is the potato?*

Questions. What is this plant? What parts are above ground? What part of the plant is the usual underground growth? Take this "potato" and trace toward the leaves. What do you discover? Compare the "potato" in size, shape and color with the stem above ground. If this is a stem, find the leaves and buds.

Material. Potato plant from the school garden.

Subject Matter. We used the whole plant to make this a real discovery. We traced from the "potato" towards the leaves and found that the "potato" is a part of the stem. It is thickened with storage food and brown from lack of sun. It is a tuber. We noted the difference between the "potato" and some of the roots. The "potato" bears organs; leaves and buds. The leaves are reduced to scales in the axils of which come buds.

Rose McDonough.

Problem 3. *How should the seed potato be selected?*

Questions. Of two hills of potatoes, one bearing twenty medium sized potatoes and the other five large ones, from which would it be best to select the seeds? In selecting seeds is maturity a factor? Color? Texture of skin? Large eyes? Quality of starch? Amount of starch? What, then, are the tests to be applied in selecting seed potatoes?

Subject Matter. In selecting seed potatoes, we have seven tests to apply: quantity, maturity, color, skin-texture, number and size of "eyes," amount of starch and quality of starch. In the case of quantity we consider the number of tubers from a plant rather than their size. A plant which produces only one good sized potato is not strong enough to bear good seed. Therefore when digging each hill select for seed those plants yielding the largest number and of medium size. The seed potato should also be mature. The color has nothing to do with the edible qualities. A smooth-skinned potato is apt to be watery and soggy after cooking; a netted-skinned one, mealy; so the latter is preferred. Large sized or numerous "eyes" are objectional because they carry dirt, and the labor, time and waste in cooking are greater. The same objections held true in the case of potatoes of irregular shape. For the starch element see problems 11 and 13.

Frances Forte.

Problem 4. *What are the "eyes" of the potato?*

Questions. Find the "eyes" of this potato. What are these "eyes?" What is the mark above them? Then why do you think they are called eyes?" Have you ever seen the "eyes" sprouting? Into what did they grow? What does this prove?

Material. Potatoes, some sprouting.

Subject Matter. The eyes of the potato are the lateral buds in the axils of minute scale leaves in the underground stem of the plant. Buds are undeveloped branches. The potato forms at the end of slender, underground branches, elongated tubers, upon which are numerous buds, "eyes," any one of which, nourished by the reserve food in the tuber may produce a new shoot, i. e. the sprouting potato. These buds, or "eyes," are formed in the axils of the scale leaves.

Evelyn Nugent.

Problem 5. *What part of the plant do we use to make new plant?*

Questions. What part of the plant would you use to make new plants? What part of the plant is the potato? Have you ever seen or heard of other stems being used in growing new plants? What part of the stem was used? What in the potato are the buds? If you were planting potatoes would you use a large one whole? Show how you would prepare this large

potato for planting. In cutting what must you have in mind in regard to the size of the pieces? May each piece grow into a potato plant? Why? About how many new plants can be grown from a medium sized potato? Are true seeds ever used in growing potatoes?

Material. Large and medium sized potatoes.

Subject Matter. For the propagating of the established varieties of potatoes the tuber or underground stem is used. The tuber compares to a slip of geranium. The buds are the "eyes." Large potatoes are not used whole because it would be wasteful. A medium sized potato may be cut into about four pieces, each of which may grow into a plant provided it has at least one eye and sufficient food for the little plant. True seeds are very rare and are used only to develop new varieties.

Alice Rebane.

Problem 6. *How can potatoes be grown to get the best results?*

Subject Matter. 1. Conditions of soil. Potatoes, unlike other crops, do not require rich soil. Wheat, and corn must have rich soil, so potatoes have become important as the main starch food for people and a money crop for the farmers, because they can be grown on sandy soil which is useless for wheat and corn.

2. Fertilizing the soil. Some farmers use fertilizer, plowing it into the soil or putting it into the drills. Commercial fertilizer, especially prepared, is best. Dairy or stable dressing, unless it is old and well-rotted, is not satisfactory, because it tends to produce conditions favorable to the development of scab. This makes the potato rough and unattractive to the buyer. Farmers have come to the conclusion that it is not absolutely necessary to fertilize the soil, because some potatoes grown in sandy soil are as good as those grown in fertilized land.

3. Planting. First the land is cultivated in deep furrows about 3 feet apart. If fertilizer is used, it is scattered along the drills and worked into the soil before the "seed" is planted. The seed potato pieces are placed along the drill about ten inches apart. The "seed" is covered with about two inches of soil. When the sprouts are well up, the drills should be hoed and at each successive hoeing the soil piled about the plants.

If the potatoes are exposed to the sunlight during growth the skins become green and the potatoes will not be salable. Particular care must be taken to keep the potatoes covered to insure their full development.

4. Preventing disease. A scale which sometimes forms on the skin of the potato, making it rough and unattractive, may be prevented by soaking the seed potatoes, whole, for two hours, in a solution of seven gallons of water to one-half cup of formalin. They should be spread out to dry before planting. With such treatment the scab disease is prevented. It is claimed that if a disease appears in the potatoes, this will be worse the following year unless a new variety be planted in that soil, as potatoes inherit the characteristics of the parent plant. When the plant begins to grow, it sometimes becomes infested with the potato beetle. See Problem 7.

5. Satisfactory yield. For one barrel of seed potatoes the average yield in the U. S. is from ten to fifteen barrels. Where there is intensive cultivation the yield is much greater in proportion.

Margaret Tuohy.

Problem 7. *What is the worst pest of the growing potato?*

Subject Matter. The principal enemy of the potato plant here is the common potato bug or more accurately, the Colorado Potato Beetle. This insect had its original home near the foothills of the Rocky Mountains, in the region of Colorado. Here it fed on the wild plants of the nightshade family to which the potato belongs. When the settlers planted the Irish Potato the beetle found an abundance of food just to its taste and so flourished beyond all previous records. It spread eastward and north into Canada, and also to Europe.

In the spring before vegetation is well up, the female comes out of the ground and flies around in search of food. It frequently works into a sprouting hill of potatoes, feeding upon the tubers as well as the sprouts. When the plant comes up the beetle deposits ten to forty yellow eggs on the under side of the leaf near the tip. The dark, reddish larvae hatch in a few weeks, after which they enter the ground to pupate. The adult beetle emerges in about a month. There are three or four generations in a year. In both larval and adult stage the beetle feeds on the potato.

As a method of prevention plants should be sprayed with Paris Green or other arsenical poison. The eggs, whenever found, should be destroyed. The larva and adult may be hand-picked into a dish of kerosene. Among the beetle's natural enemies are the chicken quail, and rose-breasted grosbeak.

Marion Duggan.

Problem 8. *How shall the potato be harvested?*

Questions. About how long does it take the plant to grow fully developed tubers? How do we know when the tubers are ripe? Is the whole plant dead? Just as soon as the plant dies, should the potatoes be dug? Why not? When the potatoes are ripe, what is the first step in harvesting? After the plant tops are pulled, what is done?

Material. A ripe potato plant.

Subject Matter. Usually from twelve to sixteen weeks after the potato is planted, the leaves and aerial stem begin to die. The plant has done its work and stored its excess food in the tubers. Ordinarily when the top dies the potatoes are almost completely ripened; if, however, from cause such as blight, the top dies prematurely, the tubers continue to ripen for sometime. In such case, a sample dug from a few hills will serve as a test of ripeness. It is wise in all cases to leave the tubers for a short time after the top dies, for they continue to ripen. When it is time to harvest, the plant tops are pulled first and thrown aside. The potatoes are then hoed or spaded and spread out on the ground for a few hours.

Katherine Donahue.

Problem 9. *What care should the potato have after harvesting?*

Questions. Should the potatoes be stored immediately after harvesting? Should they be sorted according to size and perfectness? What are the requisites for a good storing place? What places offer good storage?

Subject Matter. Potatoes should be dug on a fair day and left beside the row to dry. They should be carefully sorted. The medium and large ones should be set aside for the market, and the small ones for home consumption, as should also the ones that have been bruised in digging. The storing place should be dark, well-ventilated and free from frost. Excess of

light makes potatoes green and bitter and lack of ventilation causes them to heat and sprout. Potatoes may be stored in dry lofts and sheds, airy cellars or barns. They keep well in bags, bins or boxes and in piles on the floor, if the floor is dry.

Marion Bartick.

Problem 10. *What are the marketable qualities of the potato?*

Questions. What size would you look for in buying potatoes? Why? What color skin do you prefer in potatoes? Do you prefer rough or smooth skin? When buying would you select those with deep "eyes" and irregular in shape?

Material. Potatoes to illustrate each of the above questions.

Subject Matter. Potatoes two or three inches in length and from five to ten ounces in weight are the most salable. If smaller they do not cook uniformly and when baked or boiled whole they do not look so appetizing. There is slightly more waste in paring also. The color of the skin has nothing to do with the eating quality, but in northern latitudes the light yellow or white skins are preferred. The netted or rough skin is preferable to the smooth skin. Deep "eyes" and irregularities in shape are disadvantages. See Problem 3.

Helen Mullen.

Problem 11. *How may we know that the potato is of good quality?*

Questions. Cut the potato and break the pieces apart. What is the texture? What makes it crisp? Because of this abundance of starch what will the quality be when cooked? Cut this potato. Compare with the other. What is lacking? Which will be the better eating? Why?

Material. Firm and "soft" potato.

Subject Matter. To determine whether potatoes are of good quality a simple method is to test them with a knife. If, when cut, a snappy condition is evident, an abundance of starch grains are present, these will swell the tuber and make it mealy when cooked. A soft leatherly response shows a lack of starch and an overgrowth of fibre; this condition means a watery or soggy potato when cooked. (In an old potato, it is possible to restore an original crisp condition by peeling and standing in cold water; for the cause is largely a loss of water.)

Marian Mahan.

Problem 12. *What is the food value of the potato?*

Questions. Why do we eat the potato? What are the food substances it contains? How may we prove that it contains water? Fat? Starch? Protein? Mineral Matter? What, then, is the food value of the potato?

Material. Potato; knife; scales; two test tubes; iodine; nitric acid; ammonium hydrate; benzine; a flame; filter paper; thin paper.

(*Caution.* Keep benzine away from the flame) Questions are to be answered through experiments performed by the class under the teacher's guidance.

Subject Matter. We eat the potato because it contains certain foods that are of value to the human body and because we like the taste. The potato contains five food substances. To prove that it contains water, weigh a small potato when peeled. Put it in a warm place for a week or so then weigh it again. The loss of weight through evaporation shows the amount of its water content. (78.3 per cent) To prove that it contains fat; to a little finely chopped potato in a test tube, add a little benzine; shake thoroughly; allow a drop to evaporate on thin paper. (.1 per cent) For starch see Problem 13. Protein content; to a little chopped potato and water in a test tube add nitric acid and then heat. The mixture turns yellow. Add a small amount of ammonium hydrate and the resulting bright orange color shows the presence of protein. (2.2 per cent). For mineral matter; burn a small potato until only ash remains. (.1 per cent) Thus we see that the potato contains valuable food substances; water, which is necessary to keep the tissues of the body in proper condition; fat, which produces heat; starch which produces energy; protein, which builds up new material and repairs waste; and mineral matter which makes bones and nails.

Gertrude Schnurr.

Problem 13. *What is the amount of starch in a potato?*

Subject Matter. To find the amount of starch in a potato, I cleaned a potato thoroughly; dried and weighed it; reduced it to a pulp with a grater, then folded the pulp in a cotton cloth and washed it with considerable clear water, preserving all the wash water; after allowing it to settle, I drew off the water; the dry residue was pure starch. I weighed this starch and computed its percent of the weight of the potato. Result.

Original weight 8 ounces; starch 6 ounces. So the starch weighed 20 per cent of the total. Test by members of the class; feel the residue; test it with iodine for a blue color. Questions. Why did I clean the potato? Why was it necessary to weigh before performing the experiment? Why was it best to grate the potato? How did I obtain the starch from the grated potato? Explain how the percentage of starch was computed? About what percent of starch has the potato?

Margaret Horgan.

Problem 14. *Why should potatoes not be eaten raw?*

Experiment. Two test tubes containing equal amounts of digestive juices (pancreatin, pepsin, and hydrochloric acid); one with a portion of boiled potato added; the other with an equal portion of raw potato added. Results noted in a few hours. The test tube containing the boiled potato has been changed, the potato disappearing into the digestive juice.

Questions. Which has digested first? Why?

Subject Matter. Heat expands the water present in the potato when it is cooked, it breaks up the starch, expanding the granules, which, when raw, consist of tightly packed concentric layers. A mealy, boiled potato is, in fact, near akin to a lump of sugar, for like all starch foods, it must be turned into sugar to be absorbed into the system. Then we prefer cooked potatoes for the taste is more agreeable. Possibly, also, there are volatile bodies of more or less pronounced flavor, which are reduced by the heat of cooking. In the raw potato, the separate starch grains are enclosed in cells with walls composed of crude fibre, a material resistant to digestive juices. It potatoes were eaten raw the digestive juices would not reach the starch easily unless the walls happened to be ruptured mechanically, as in mastication.

Dorothy Johnson.

Problem 15. *How may potatoes be cooked?*

Questions. Why are potatoes cooked? How are they cooked? Which is the best way? How long should they be cooked? What is added before eating? Why?

Subject Matter. We cook potatoes to break up the cell walls of the starch granules, thereby making it possible for the digestive juices to attack the food more easily. Potatoes may be cooked in three different ways. Baking is the best method for

then the starch granules are almost turned to sugar. Boiling is next, and then frying. In frying a coat of fat forms around them making it very hard for the digestive juices to reach the other elements. Potatoes are largely starch and water, so salt and butter are added before eating; salt to make more tasty and to give larger mineral content; butter to give necessary amount of fat. The addition of milk increases the protein content. Sometimes these ingredients are added before serving, as in mashed potatoes; sometimes before cooking, as in escalloped potatoes.

Helen Denehy.

Problem 16. *What are the differences between the common and the sweet potatoes?*

Questions. Compare sweet and common potatoes in appearance; examine the cut ends also. Which contains more starch? More water? Which is the more digestible? What part of the plant is each? To what families do they belong? Which is the cheaper in Boston? Why?

Subject Matter. The common potato is a storage stem; the sweet, a tapering root. The sweet is yellow inside, the common, white. The yellow contains more starch (27 to 30 per cent, while the white has 17 to 20 per cent). The white contains more water (sweet about 68 per cent; white about 78 per cent). The white is more digestible due to the character of the starch grains. The white belongs to the nightshade family; the sweet to the morning glory. In Boston the white is the cheaper, because it is commonly raised in this vicinity.

Marion Martijke.

Problem 17. *What is the origin of the various names for the potato?*

Subject Matter. Potato is an altered spelling for the Spanish "patata." They are called "paitey" in Ireland, the Irish way of pronouncing the Spanish. In France they are called "pomme de terre" because the potato is looked upon as the apple was as regards food value but was taken from the earth, thus the "de terre." It was called also "patate." In England they are called "crokers" for the first British potatoes were planted in Croker's field at Youghal, Ireland. They were also called Irish potatoes because they had become so popular in Ireland. They are called "Murphies" because they are the chief article

of diet among the Irish peasantry. This term is also current in the farmer's tools for digging so commonly used in digging potatoes, and thus the name was transformed to the crop most universally grown and dug.

Helen Murphy.

Problem 18. *Are potatoes commonly grown and used in countries other than the United States?*

Questions. Are potatoes grown in countries other than the United States? What is true of the amount grown as compared with that grown here? Why do we sometimes find the output of a small country as much as that of a large country? What is the general location of the peoples growing potatoes? How are potatoes used in other countries? Compare the amount with that of other food stuffs.

Material. Outline map of the world.

Subject Matter. Potatoes are grown in Germany, Russia, Austria, France, England, Canada and other parts of the United Kingdom. The following table gives a general estimate of the amount grown by the different countries. Germany, 2,000,000,000; Russia, more than 1,000,000,000; Austria-Hungary, 7,000,000,000; France, 500,000,000; U. S., 3,000,000,000 bushels.

In fact the potato crop usually outranks all but the cereal crop. By rotating the crops and using fertilizer a large crop may be grown on a small tract of land year after year. With this intensive cultivation a small country may grow more than a large country which does not practice intensive cultivation. By consulting the outline map we discover that the great potato producing countries are in the temperate zones. In many countries, potatoes are grown for the starch and many factories are found in potato producing countries. Germany has discovered the art of making potato flour which is used extensively in Germany and Sweden. She has also manufactured an alcohol from a large, flavorless potato which produces an oil abundantly. This oil is distillized into an alcohol used for fuel and drinking purposes. The potato is probably exceeded only by bread by the number of times it is eaten by the average American and Europeon. It has established itself as the great cool-climate starch food. The potato rivals rice in supplying starch upon the tables of Europe and America.

Vera Flaherty.

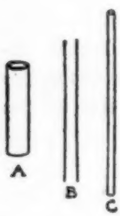
Manufacture of Edison Mazda Lamps

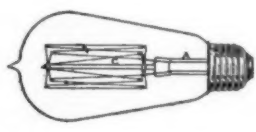
EDWARD B. FOX, *Commercial Engineering Dept., Edison Lamp Works.*

In response to many urgent requests we give here a short explanation and description of the principal steps in lamp making, and in order to avoid long descriptions we will use many small sketches. Incandescent lamp manufacture is such a complex and highly technical process that in order to confine the article to a few pages it will be possible to describe only the major operations in the briefest manner.

It requires about 50 different materials to make a lamp, the operations will number around 75, and there are at least 20 inspections to make sure that both the work and material are of the highest quality.

The incandescent lamp itself is comparable with a laboratory instrument in refinement of construction. The filament diameter is measured to a ten-thousandth of an inch, the length to a few thousandths and the exhaust obtained on the pumps is 99.999 per cent of a perfect vacuum.





MAZDA B LAMPS (Vacuum)

Stem Making

Lamp stems are made up of glass stem tube (A) lead wires (B) (alloy substitute for platinum) with the same co-efficient of expansion as glass so there is little chance of a leak and cane glass (C).

On the stem making machine the tube (A) is flanged as at (D), the leads (B) are inserted and sealed into the stem press (E) which is the joint made by melting and pressing (A) and (C) together.

Anchoring

The inserting machine is one of the most ingenious used in lamp manufacture. It makes the buttons by melting down and pushing together the cane (C) at (F) and (G), inserts the tungsten supports (H), bends them in the shape of hooks and cuts them off.

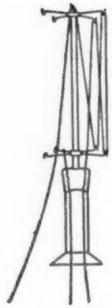
The number of supports, size and spacing depend on the wattage and voltage of the lamps to be made.

Wire Drawing

The filament (I) is tungsten which has been drawn down to a fine wire through a series of diammond dies (J) and is so ductile that it can be tied in knots. Diamonds are used because they are so hard that the hole drilled in them will wear larger very slowly and it is possible to draw the tungsten wire down to the correct size with great accuracy.

Gettering

Before the filament is draped or wound on the supports it is run through a chemical solution called getter which forms a coating on its surface. This getter is very valuable as it keeps the bulb clear, by retarding the formation of dark metallic deposits on the inner surface, thus increasing the amount of light given out during the life of the lamp.

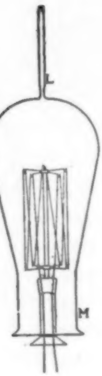


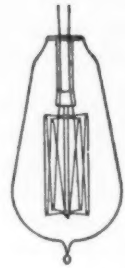
Draping

The filament is draped by hand but a very clever motor-driven clamp is used to press the tungsten wire into the softer lead wires. After the stem is draped and the filament has been pressed into the second lead and cut, the end of the wire from the spool is still held by the clamp so that the operator does not have to search around for this thin wire before starting to drape the next stem. This saves a great deal of time.

Cracking Off and Tubulating

Lamp factories receive bulbs from the bulb works in the form shown in the sketch and it is first nec-

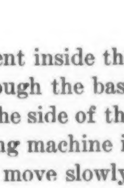




essary to crack off the end of the bulb (K), then make a small opening in its top and attach a glass tube (L) which is later used in drawing the air out of the bulb after the stem has been sealed in it. This sealing-in is accomplished by melting in the bulb at (M) until it has joined with the flange of the stem as at (N).

Exhaust

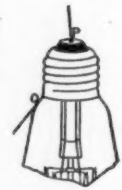
The lamp is now ready to have the air drawn out through the top tube and for this purpose it is put on a rotary exhaust machine. This machine is equipped with an oven which heats and expands the air in the bulb so that most of it can be removed and there are pumps connected to suck out this air after it is heated. When the lamp has passed around the exhaust machine and the vacuum has been tested by an induction coil spark the top tube is melted off with a gas flame close to the bulb, making a tip (O).



Basing and Soldering

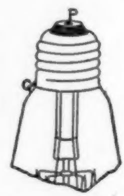
Operators put a ring of basing cement inside the edge of the base, thread one lead through the base eyelet and bend the other back along the side of the lamp and fit the base on it. The basing machine is a circular oven through which lamps move slowly.

In passing through this oven, alcohol is burned out of the basing cement leaving it firm and solid. The operator cuts off the lead wires at P and Q and fastens each lead with a drop of solder at these points to the brass base.



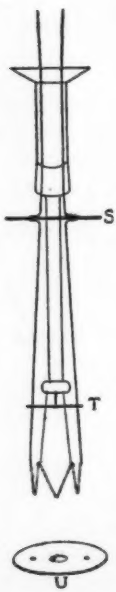
Flash Aging

It will be noted that up to this point the lamp has not been lighted and the last step before cleaning and final inspection is called flash aging. The lamp is placed in a socket on a large rotating wheel and as it moves over different contact points the voltage gradually goes up until all the harmful gases have been absorbed. After this action has taken place the lamp is burned for a short time well over the rated voltage and the vacuum is improved until the pressure in the lamp is about one five-millionth of an atmosphere. This is quite a little better than it was when the lamp was sealed off on the exhaust pumps. This test permits the operator to detect and remove any lamp having a poor vacuum or other defects.



MAZDA C LAMPS: (Gas Filled)

These lamps are filled with nitrogen or argon and are made in about the same way as MAZDA B lamps except for a few very important differences.



Coiled Filament

First, the filament (R) is coiled so that the inert gas which surrounds it does not get as much chance to cool it off by conducting the heat away.

Supports

Second, there are fewer supports and the coils are suspended from them as in the sketch.

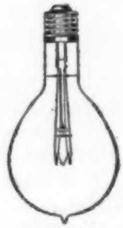
Discs

A mica disc (U) is placed in the larger lamps at (S) and keeps the heat from getting down in the neck of the lamp and affecting the stem press.

On some of the very large lamps another mica disc is used at (T) to protect the glass button and keep it from softening.

Exhaust

The exhaust is different for after the air has been removed an inert gas is put in at about two-thirds atmospheric pressure and the lamp sealed off. When the filament is burning this pressure is very much increased as the gas becomes heated and expands. The pressure of the gas keeps the filament from vaporizing at as low temperatures as it would in a vacuum. For this reason the filament can be burned at a much higher temperature and still give 1000-hour life. At this higher temperature an increased amount of energy is given off as light and less as heat than at a lower temperature, which means that the lamp is more efficient or gives more light for a fixed wattage.



MAZDA C LAMP

Inspections

As mentioned before there are, after each of the operations of lamp manufacture in the factory, very careful inspections of the lamps or lamp parts and all defects are thrown out. Also before the lamps are packed a proportion of each tray is photometered to see that the watts, volts, amperes and spherical candle-power are correct.

Science Club Activities

GENERAL SCIENCE CLUB

The General Science Club of New England, now in its fifth year, is showing greater activity than at any time in the past. The president, Mr. J. Richard Lunt, believes that a "New England" club should not hold all its meetings in Boston, and proposes to plan meetings in other cities and different states where a local general science enthusiast can be found to cooperate. The tentative plans call for meetings in four different states.

The first meeting of the school year was in a joint session with the Eastern Association of Physics Teachers and the New England Association of Chemistry Teachers. This was held at Boston University, Dec. 4, 1920. These same clubs joined with the Association of Colleges and Secondary Schools at a dinner at Massachusetts Institute of Technology the evening of Dec. 3, 1920. The program at the joint science session Dec. 4 was as follows:

"The What, Why and How of General Science" by Howard C. Kelley, High School of Commerce, Springfield, Mass.

"Methods of Vitalizing the Study and Teaching of General Science in the Intermediate School," J. Richard Lunt, English High School, Boston, Mass.

"Forest Bi-products" by Dr. Gustavus Esselen of Arthur D. Little, Inc. Consulting Chemists.

"The Appeal of Physics to the Secondary School Pupil." Different methods illustrated by eight experienced teachers.

The ninth regular meeting was held at the Girl's High School, Boston, Feb. 12, 1921. Following is the program:

"Minimum Requirement in General Science." Adelbert H. Morrison, Mechanic Arts High School, Boston.

"A Practical Lesson illustrating the Value of Minute Observation." Carleton E. Preston, English High School, Boston.

"A Ventilation Problem demonstrated by girls of the Eighth Grade." Ella M. Donkin, Dillaway School, Roxbury.

"Micro-organisms and How to Teach Them. Teaching Problems and Microscopic Demonstrations." Sarah E. Potter, Girls High School, Boston.

In the afternoon the club visited the bacteriological laboratories of the State Board of Health and listened to an address on *"The Value of Bacteriological Examinations for the Control and Prevention of Disease,"* by Philip Castleman, M. S., M. D., Deputy Health Commissioner, Boston.

On February 19, a meeting was held in Springfield, Mass., "the birthplace of general science." Howard C. Kelley and committee prepared the following program:

"Visual Education in Massachusetts," Philip Davis, Boston, Massachusetts.

Lecture, illustrated by experiments—*"What Should We Teach About Food at the Present Time?"* Lewis B. Allyn, Director of McClure Laboratory, Westfield, Mass.

"Motion Pictures for Class Room Instruction." N. Earl Pinney, Albany, New York.

Special demonstrations by experienced teachers.

Examination of Exhibits.

Note: These exhibits are to consist of home-made apparatus and devices, special set-ups for experiments and demonstrations, manufacturers' exhibits, charts of courses, etc.

The wisdom of President Lunt's views on "outside" meetings was clearly shown by the large and enthusiastic group in attendance. Seventy-four teachers came to the meeting, nearly as many as attend the Boston meetings and twenty teachers joined the club.

Mr. W. G. Vinal, the genial nature study specialist and general science enthusiast of the Rhode Island College of Education, prepared the following program for the General Science Club meeting in Providence, March 12, 1921.

"The Modified Project Method." J. Herbert Ward, Classical High School, Providence.

"Projects as Hobbies." Dr. Marion Weston, President R. I. Field Naturalists' Club.

"General Science as Viewed by a Physiographer." Robert Marshall Brown, Professor of Geography, R. I. College of Education.

"Some Lecture Table Experiments." Herbert F. Davison, Professor of Chemistry, Brown University.

It is proposed to have another rousing meeting in Boston in May, and it is possible that some talent outside New England will be "imported" for that occasion.

A goodly number of new members have been added this year. There are some others who ought to join. If you live in New England why not call the attention of some of your science teacher friends to the General Science Club. Tell them it is a *live* organization and if they wish to keep *alive* in their profession, this is a means of doing it.

The next meeting will be held in Boston, May 14th. Set aside the day for this meeting. There will be inspiring speakers, practical demonstrations and educational movies.

NEW ENGLAND CHEMISTRY TEACHERS

The New England Association of Chemistry Teachers is out to double its membership. Secretary Hoyt is directing a strenuous Reconstruction Drive which is yielding results. To date over sixty new members have been added in this 1921 drive. At their last meeting besides the reports of standing committees, two addresses were on the program: *"The Storage of Food Products in Massachusetts"* by Mr. H. C. Lithgoe, Massachusetts Board of Health. *Explosives*, by Prof. T. L. Davis, M. I. T.

Two sectional meetings have already been planned: one in Providence, R. I., May 7 and another in New Haven, Conn., May 14.

MOHAWK VALLEY SCIENCE TEACHERS MEET

The Mohawk Valley Science Teachers' Association held a meeting in Utica, February 18th and 19th with the following program:

"Our Ideals in Biology." ..Round Table—Misses Kemper, Smith and Prentiss of Utica Free Academy.

"Projects and Their Relation to Science Teaching." Dr. Clarence F. Hale, State Teachers College, Albany.

"The Rating of Regents Papers in Biology." Grace S. Waterman, State Education Department.

"Laboratory Problems and Their Solution." C. A. Stanton, Utica Free Academy.

Mr. M. C. Collister of Utica Free Academy was elected President of the Association for the ensuing year.

Free Books and Pamphlets

Creative Chemistry. This delightful book which is reviewed in another place is offered free to readers of General Science Quarterly until the supply is exhausted. Since the available supply is not large, act without delay, if you wish a copy. Apply to *The Chemical Foundation,* 81 Fulton Street, New York City.

Photography. Four helpful pamphlets just issued are *"About Lenses," "By Flash-light," "Elementary Photographic Chemistry,"* and *"Bromide Enlarging with a Kodak."* For these send to Eastman Kodak Company, Rochester, New York.

House Cleansing Made Easy. Farmers' Bulletin 1180.

An Agricultural Almanac for 1921. Farmers' Bulletin 1202.

How teachers may use Farmers' Bulletin 1087. "Beautifying the Farmstead." Department Circular 155.

Plans of Rural Community Buildings. Farmers' Bulletin 1173. The last four may be obtained from the U. S. Department of Agriculture, Washington, D. C.

POPULAR SCIENCE MONTHLY, 225 West 39th St., New York, is supplying over 2000 high schools with their free Monthly Service Sheets for teachers of science and industrial education. In this service sheet references to articles in one number of Popular Science Monthly are grouped under "Physics," "Chemistry," "Biology," for elementary or general science pupils. Then a classification of science articles for high school pupils is made and finally a classification under "Industrial and Manual Acts." The listing of articles usually is accompanied by brief notes—pointed questions or suggestions about the use of the material in the classroom. The science groups are under the charge of Morris Meister, of Teachers College, Columbia University and the industrial and manual acts group is in charge of A. H. Edgerton, Inddiana University. If you have not seen these sheets, send for a sample at least and try them out.

Book Reviews

Civic Science in the Home.—G. W. Hunter and W. G. Whitman, American Book Company. 416 pages—300 illustrations.

"Civics Science in the Home" is an introductory general science text written in language easily understood by pupils in any junior high school grade or in the seventh or eighth grade of the elementary school. The science topics of the home are treated in a way to bring out the relation between the home and the community and to impress the pupils with the importance of good citizenship. Each chapter opens with a statement of definite problems and a list of optional projects; some projects are in part outlined to assist the pupil in getting a start. Each chapter closes with a carefully selected bibliography. Here and there are lists of "thought questions". Quite extensive use of the score card has been made as a device to bring the school work into vital contact with home conditions and to lead the pupil not only to see what improvements are needed but in some cases actually to make the improvements.

A companion volume "Civic Science in the Community" is in the press. Together these books will make an excellent junior high school science series.

Principles of Human Geography—Ellsworth Huntington and Sumner W. Cushing—John Wiley and Sons—430 pages—118 figures—price, $3.50.

Here is something new. The process of humanizing geography has been under way for a long time. Its need has long been felt, but it has fallen to these two men to produce the first geography text, which has for its main theme "the relation of the physiographic environment to man's activities." It is this human side of geography that the usual text omits or treats rather incidentally. For this reason "Principles of Human Geography" is a pioneer. Its numerous maps and half-tone illustrations are a valuable part of the work. There are twenty-two chapters grouped into eight parts as follows: Man's Relation to Physical Environment—Man's Relation to Loca-Water—Man's Relation to Soil and Minerals—Man's Relation to Climate—Man's Relation to Vegetation and Animals—Man's Relation to Man.

The problems at the chapter ends require student activity and offer varying degrees of difficulty. They add a very strong educational feature to the book. The language of the book is well within the comprehension of high school students. It is intended to be used as a text in high schools, normal schools, or colleges. Every science teacher as well as every geography teacher will find it a splendid book of reference.

Creative Chemistry—Edwin E. Slosson. The Century Company. 311 pages—illustrated with line cuts and half tones—$2.50.

Creative Chemistry gives a popular account of recent chemical industrial achievements. The book is intensely interesting to one without chemical knowledge and will find a welcome as collateral reading by high school chemistry students. It treats by chapters: three periods of progress; nitrogen; feeding the soil; coal tar colors; synthetic perfumes and flavors; cellulose; synthetic platics; the race for rubber; the rival sugars; what comes from corn; solidified sunshine; fighting with fumes; products of the electric furnace; metals, old and new.

Here are recorded many of the wonders of chemistry; how the chemist has revolutionized warfare, turned barren waste to fertile fields, changed waste material into products of value, and has altered nature for the benefit of mankind.

Creative Chemistry should find a place in every high school library and teachers will find it a valuable aid in their class work.

A Laboratory Manual of the Invertebrate Zoology (third edition) Gillman A. Drew. W. B. Saunders—229 pages—$2.25.

The book is an outgrowth of the zoology course given at the Marine Biology Laboratory at Woods Hole. The matter is arranged in a strictly scientific and logical order. However, it is not necessary to follow this order in actual work. Directions are given but in some cases complete directions are not given as it is believed that to a certain extent there is value in the Agassiz Method. The work outlined leads to the knowledge of comparative anatomy and to an appreciation of adaptation. There are suggestions for making permanent comparisons and a useful glossary will be found at the end of the book.

History of the Teaching of Chemistry, S. R. Powers—68 pages—published by University of Minnesota. $.50.

This valuable pamphlet is *Current Problems No.* 13 of the research publications of the University of Minnesota. The work is

limited to the chemistry teaching in the secondary schools of the United States previous to 1850. It gives a most interesting account of science beginnings covering a period generally considered devoid of science teaching. This is a splendid contribution to the history of science and to the history of education, as well.

Maxwell's First Year Science Tests, P. A. Maxwell, Avalon, Pa. Published by author. $1.75 per 100 copies.

The information tests and reasoning tests first published in General Science Quarterly, in May, 1920, have been tried out and revised. Two series, A and B, are now ready. Each series comprises thirty information questions and eight reasoning problems. Half an hour is required to give the test. General Science teachers will find these tests both interesting and valuable.

Education and Accident Prevention. E. George Payne—Lyons and Carnahan—176 pages—illustrated.

The conservation of human life is beginning to appear worthy of some attention by the general public. There is no more promising field in instilling the fundamental principles of safety than with the children in our schools. This little book is a record of what is now being done in the St. Louis Schools. It gives statistics to justify the teaching of the subject then shows how it may be taught through language instruction, drawing, arithmetic and other subjects. It gives a program of pantomine and suggests school organization to prevent accidents. Work is suggested for each grade up through grade eight.

Elementary Biology—Benjamin C. Gruenberg—528 pages—261 illustrations—Ginn and Company.

Elementary Biology is not only attractive to look at, but is interesting to read. The author has succeeded well in his attempt to "humanize the study of living things in terms of appreciation and purpose." "Man's conquest of his surroundings, through the application of more and more knowledge, through the making of his knowledge more and more trustworthy, furnishes a leading motif." The ninety-one chapters are grouped into six parts as follows: The world in which we live; life processes of the organism; the continuity of life; organisms in their external relations; heredity and evolution; man and other organisms. The appeal to the pupil is strong since practical life is emphased. We are told what plants and animals *do* rather than what they *are*. The book is clearly written and is adapted to the use of high school pupils:

Common Science—Charles W. Washburn—World Book Company. Through an error the price of this book was given as $1.60 in our last number. The price is $1.68.

SCIENCE ARTICLES IN CURRENT PERIODICALS

AERONAUTICS

- Aeronautic instruments. Ill., Chas. E. Mendenhall, Jo. Fr. Inst. 191:57-86. Jan. 1921.
- Air power vs. sea power. Ill., Brig.-Gen. Wm. Mitchell. Rev. of Rev. 63:3:273-7. Mar. 1921.
- America in the air. Ill. Wm. Mitchell. Nat. Geog. Mag. 39:339-352. Mar. 1921.
- Building a rigid airship. Ill. Sci. Am. 124:50-1. Jan. 15, 1921.
- Controlling the airplane at 20,000 feet. H. C. McComas. Sci. Mo. 12:3:36. Jan. 1921.
- From London to Australia by aeroplane. Ill. Sir Ross Smith. Nat. Geog. Mag. 39:229-339. Mar. 1921.

AERONAUTICS

The air-mail in peril. Lit. Dig. 68:5:16. Jan. 29, 1921.
Why "the mails must fly." Ill. H. Mingos. Com'l. Amer. 7:7:29. Jan. 1921.
The physics of flight. Ill. D. L. Webster. Jo. Fr. Inst. 189:553-580. May 1920.
The 18-passenger airplane. Ill. L. J. Wilson. Pop. Sci. Mo. 98:3:33. Mar. 1921.
Why balloons bounce off clouds. C. P. McDarment. Sci. Am. 124:125. Feb. 1921.

ALPS

The natural regions of the French Alps. Ill. Raoul Blanchard. Geog. Rev. 11:31-44. Jan. 1921.

ANIMAL LIFE

Woodchucks and porcupines. Ill. R. W. Shufeldt. Amer. For. 27:147-154. Mar. 1921.
American bears. Ill. R. W. Shufeldt. Amer. For. 27:22-31. Jan. 1921.

ASTRONOMY

Keeping track of the moon. Ill. Isabel M. Lewis. Sci. and Inv. 8:986-7. Jan. 1921.
Measuring the great suns of the universe. H. T. Wade. Rev. of Rev. 63:2:197-8. Feb. 1921.
Measuring the invisible. Lit. Dig. 68:5:27. Jan. 29, 1921.
The limits of the universe. Svante Arrhersino. Sci. Am. Mo. 3:4-6. Jan. 1921.
The end of the world. Ill. L. J. Wilson. Pop. Sci. Mo. 98:2:46-48. Feb. 1921.
Astronomy Number. Sun: moon: eclipses: tides: constellations. Nat. St. Rev. 17:1:6-32. Jan. 1921.

AUTOMOBILE

A pioneer automobile 28 years old. Cur. Opin. 70:262. Feb. 1921.
Auto-bungalow touring within reach of all. W. H. Hunt. Pop. Mech. 35:336. Mar. 1921.
History of motor car industry graphically told. Sci. Am. 124:1. Jan. 1. 1921.
The trend of design. Ill. V. W. Page. Sci. Am. 124:4-5. Jan. 1. 1921.
The trend of motor truck design for 1921. Ill. V. W. Page. Sci. Am. 124:30-1. Jan. 8, 1921.
Where is the rattle? Ill. Sci. Am. 124:8. Jan. 1, 1921.
What wheels shall I use? Ill. R. W. Bradbury. Country Life. 39:3:69. Jan. 1921.
When motor-truck trailers pay. Ill. Joseph Brinker. Pop. Sci. Mo. 98:3:79. Mar. 1921.

BALKANS

The whirlpool of the Balkans. Ill. G. H. Moses. Nat. Geog. Mag. 39:179-197. Feb. 1921.

BIOLOGY

Is oxygen necessary for animal existence? O. Krummacher. Sci. Am. Mo. 3:37-8. Jan. 1921.

BOATS

Electricity for marine propulsion. Ill. W. T. Donnelly. Com'l. Amer. 17:8:43. Feb. 1921.

BOTANY

Plants that science put on the map. R. S. Pearce. Ill. World. 34:855. Jan. 1921.

The Botanical Garden of New York. Ill. H. A. Gleason. Sci. Am. Mo. 3:24-7. Jan. 1921.

The dynamics of plant respirations. Camillo Acqua. Sci. Am. Mo. 3:28-30. Jan. 1921.

BREAKERS

Fighting breakers with bubbles. Lit. Dig. 68:7:24. Feb. 12, 1921.

BRIDGES

A great builder of great bridges; Lindenthal. Cur. Opin. 70:182. Feb. 1921.

The bridge as a test of civilization. Ill. K. Waule. Sci. Am. Mo. 3:201-4. Mar. 1921.

Plan enormous new bridge for N. Y. C. Pop. Mech. 35:368. Mar. 1921.

BUDDING

The budding story step by step. J. L. Doan. Gar. Mag. 33:42-3. Mar. 1921.

CHEMISTRY

The biggest things in chemistry. W. R. Whitney. Jo. Ind. and Eng. Chem. 13:161. Feb. 1921.

CLOTH

What weather does to cloth. Lit. Dig. 68:9:22. Feb. 26, 1921.

COAL

Coal doomed by the coming age of oil. Lit. Dig. 68:8:24. Feb. 19, 1921.

What becomes of our coal. Sci. Am. 124:181. Mar. 5, 1921.

COMMUNICATION

Recent attainments in wired radio. Ill. R. D. Duncan. Jo. Fr. Inst. 191:23-56. Jan. 1921.

COMMUNITY PLANNING

Smoke banished; millions made by using "air rights." Ill. L. D. Greene. Ill. World. 35:49-52. Mar. 1921.

DIET

Contribution of European experience on low diet to our teaching of dietetics. A. F. Morgan. Jo. Home. Econ. 13:58. Feb. 1921.

DIVINING ROD

Is the divining rod a fake? T. O'Connor Sloane. Sci. and Inv. 8:1080. Feb. 1921.

DUST

Dust as an industrial criminal. Cur. Opin. 70:261. Feb. 1921.

Problems of preventing dust explosions. Ill. D. J. Price. Sci. Am. Mo. 3:239-242. Mar. 1921.

EDISON

Edison on super-labor-saving machines. J. H. Collins. Pop. Sci. Mo. 98:2:31. Feb. 1921.

ELECTRICITY

Capturing electricity from the air. T. A. Marchmay. Sci. Am. Mo. 3:39-43. Jan. 1921.

The electric bell. Ill. G. L. Hoadley. Sci. and Inv. 8:386. Aug. 1920.

Reading the household meter. Ill. G. L. Hoadley. Sci. and Inv. 8:1089. Feb. 1921.

EUGENICS

Blue-white eyes and brittle bones. Lit. Dig. 68:6:28. Jan. 29, 1921.

Our drift towards degeneracy. Lit. Dig. 68:10:21. Mar. 5, 1921.

EUROPE

The new map of Europe. Ill. R. A. Graves. Nat. Geog. Mag. 39:157-178. Feb. 1921.

EXPLOSIVES

Initiations of military explosives. Wm. A. Corley. Jo. Fr. Inst. 191:87-119. Jan. 1921.

FIRE EXTINGUISHERS

Poisonous gases from carbon tetrachloride fire extinguishers. Fieldner, Katz, Kinney and Longfellow. Jo. Fr. Inst. 190: 543-566. Oct. 1920.

FLOWERS

Care and arrangement of flowers. Ill. B. F. Letson. Coun. Life. 39:5:35-41. Mar. 1921.

How shall I make a garden? Ill. Henry Gibson. Coun. Life. 39:5:42-3. Mar. 1921.

Wild flower garden. Ill. Lewis Theiss. Coun. Life. 39:5:46-9. Mar. 1921.

"Potting" explained. P. B. Prior. Gar. Mag. 33:30. Mar. 1921.

FOOD

After-the-war economic food problems. A. E. Taylor. Jo. Home Econ. 13:1-13. Jan. 1921.

Food Economy Kitchen and its value in the community. H. Dresser. Jo. Home Econ. 13:33-5. Jan. 1921.

The Roland Park community Kitchen. Alice E. Baker. Jo. Home Econ. 13:35-8. Jan. 1921.

A food expert's inditement of the "colories." Cur. Opin. 70:380-1. Mar. 1921.

GARBAGE

Validity of garbage ordinance. A. L. H. Street. Am. City. 24:2: 183. Feb. 1921.

GARDENS

When you make your plans. Ill. Henry Gibson. Gar. Mag. 32: 232-5. Jan. 1921.

Planning a 1-acre fruit garden. J. L. Doan. Gar. Mag. 32:242. Jan. 1921.

The real usefulness of tools that fit. Gar. Mag. 32:312-316. Feb. 1921.

The practical side of planting and transplanting. Ill. A. D. Taylor. Gar. Mag. 33:21-2. Mar. 1921.

An ideal seed order for ½ acre vegetable garden. A. Kruhm. Gar. Mag. 33:35-6. Mar. 1921.

Berries to your needs. L. R. Harthill. Gar. Mag. 33:36-7. Mar. 1921.

GAS LIGHTING

Gas lighting, past, present and future. Howard Lyon. Trans. Ill. Eng. Soc. 16:1-12. Feb. 1921.

GEOGRAPHY

The evolution and distribution of race, culture and language. Ill. Griffith Taylor. Geog. Rev. 11:54-119. Jan. 1921.

GULF STREAM

Treasure-house of the Gulf Stream. Ill. John Oliver La Gorce. Nat. Geog. Mag. 39:53-68. Jan. 1921.

Interesting citizens of the Gulf Stream. Ill. John T. Nichols. Nat. Geog. Mag. 39:69-84. Jan. 1921.

GUNS

Most powerful coast defense guns yet built. Sci. Am. 124:91. Jan. 29, 1921.

HEALTH

A new outlook in the conquest of disease: chemo-therapy. Ill. T. M. Prudden. Rev. of Rev. 63:65-79. Jan. 1921.

National waste through ill health. H. W. Lanier. Rev. of Rev. 63:3:299-303. Mar. 1921.

New theories and methods of vaccination. Sci. Am. Mo. 3:30-32. Jan. 1921.

The cult of the sound body. Sci. Am. Mo. 3:33-36. Jan. 1921.

Diphtheria from cats. Lit. Dig. 68:9:24. Feb. 26, 1921.

Keeping everybody well. A. S. Richardson. Woman's Home Companion. 48:3:26. Mar. 1921.

HEAT

Thermal conductivity of building materials. C. Schroeder. Sci. Am. Mo. 3:243. Mar. 1921.

HELIUM

Helium: its history, properties and commercial development. R. B. Moore. Jo. Fr. Inst. 191:145-197. Feb. 1921.

HOMES

What one should know about chimneys and fireplaces. Ill. James Van Alst. Coun. Life. 39:5:61. Mar. 1921.

Common sense in planning your grounds. Ill. E. S. Stiles. Gar. Mag. 32:236-8. Jan. 1921.

Four prize kitchens. Ill. Woman's Home Companion. 48:3:32. Mar. 1921.

HOUSES

Saving work is motive of unusual house. Ill. P. H. Woodruff. Pop. Mech. 351:65. Jan. 1921.

The approach to the house. Ill. Roger B. Whitman. Coun. Life. 39:3:44. Jan. 1921.

Disposing of the rainfall. Ill. E. C. Stiles. Coun. Life. 39:5:71. Mar. 1921.

The all-white house. Ill. C. V. Boyd. Woman's Home Comp. 48:3:49. Mar. 1921.

HYGIENE

The breath of life. Sci. Am. 124:141. Feb. 19, 1921.

INSECT PESTS

Imported pests. Ill. Lit. Dig. 68:2:28. Jan. 8, 1921.

Insect ravages in our forests. Ill. S. R. Winters. Sci. Am. 124:48. Jan. 15, 1921.

Magazine List

American City. The Tribune Building, N. Y. C. Monthly. $4.00 a year, 50c a copy. The science problems of city and rural communities are treated in numerous articles, well illustrated. A valuable student and teacher reference.

American Forestry. Washington, D. C. Monthly. 30c a copy, $3.00 a year. Splendid pictures for plant and tree study.

Commercial America. Phila. Com'l Museum, Phila., Pa., $2.00 a year. Ill. Commercial production. New Inventions. Will interest Commercial geography and science teachers.

Current Opinion. 65 W. 36 St., N. Y. Monthly. 35c a copy, $4.00 a year. Has a regular department "Science and Discovery" containing articles of popular interest, adapted to pupil or teacher's use.

Country Life, The New. Garden City, N. Y. Monthly. 50c a copy, $5.00 a year. Stands at the head of publications dealing with life in the country. Special interest to the general reader and has many articles on gardening and plant study valuable for school use.

Everyday Engineering Magazine. 33 W. 42 St., N. Y. Monthly. 20c a copy. $2.00 a year. Ill. Popular articles on science and mechanics. Much of it is simple enough for elementary pupils.

Garden Magazine. Garden City, N. Y. Monthly. 25c a copy, $3.00 a year. Ill. Helpful to amateur gardeners, teachers and pupils.

General Science Quarterly. Salem, Mass. Quarterly. 40c a copy, $1.50 a year. The only journal published devoted alone to science in the elementary and secondary schools. It tells what schools are doing in science, gives lesson plans, demonstrations, and an extensive bibliography of usable articles in current periodicals.

The Geographical Review. Broadway at 156th St., N. Y. 50c a copy $5.00 a year. Devoted to scientific geography. Original maps and pictures. One department contains condensed items on topics of current interest.

The Guide to Nature. Sound Beach, Conn. Monthly. 15c a copy, $1.50 a year. Ill. Of interest to elementary pupils and teachers of nature study.

Illustrated World. Drexel Ave. and 58th St., Chicago. Monthly. 25c a copy, $3.00 a year. Many short articles on applications of science and mechanics. Popular in style and attractive to elementary and high school pupils.

Journal of the Franklin Institute. Philadelphia, Pa. Monthly. 50c a copy, $5.00 a year. Ill. A technical journal. Contains many articles of value to science teachers.

Journal of Home Economics. 1121 Cathedral St., Baltimore. Monthly. 25c a copy, $2.00 a year. For teachers.

The Literary Digest. 354 Fourth Ave., N. Y. Weekly. 10c a copy, $4.00 a year. Has a department "Science and Invention." Articles are mostly digests from other journals. They are popular in nature and suitable for high school pupils.

Journal of Industrial and Engineering Chemistry. Box 505, Washington, D. C. 75c a copy, $7.50 a year. A technical journal which contains much material which teachers can use. Monthly.

INVENTION
Leonardo De Vinci as an inventor. Ill. A. A. Hopkins. Sci. Am. Mo. 3:263. Mar. 1921.

IRRIGATION PROJECTS
Something for nothing. Ill. C. H. Claudy. Sci. Am. 124:32. Jan. 8, 1921.
What makes the West grow? Ill. W. V. Woehlke. Rev. of Rev. 63:2:181-191. Feb. 1921.
Third of a billion irrigation project. Ill. World. 35:117. Mar. 1921.

LIGHTNING
"Chain lightning" an illusion. Lit. Dig. 68:3:25. Jan. 15. 1921.

MACHINES
Engineers of ancient Egypt. G. A. McWilliams. Sci. Am. 124:132. Feb. 12, 1921.

MICROSCOPY
Microscopy with ultra-violet light. J. E. Barnard. Sci. Am. Mo. 3:219. Mar. 1921.

MOTORS
Ancestors of the Liberty Motor. Ill. Carl W. Mitman. Sci. Am. Mo. 3:247-250. Mar. 1921.

MUSEUM
The Commercial Museum and its work. Ill. S. A. Bonnaffon. Com'l. Amer. 17:9:29. Mar. 1921.

NAVY
Leading navies compared. Ill. Sci. Am. 124:130. Feb. 12, 1921.

PAINTING
Spray painting. Ill. H. A. Gardner. Sci. Am. Sup. 3:235. Mar. 1921.

PANAMA CANAL
Panama Canal facts. Ill. Sci. Am. 124:70-1. Jan. 22, 1921.

PHONOGRAPH
A talking machine that uses thread for records. P. Schwarzboch. Pop. Sci. Mo. 98:2:83. Feb. 1921.

PHOTOGRAPHY
Nature photography. Ill. R. W. Shufeldt. Am. For. 27:76. Feb. 1921.

PLAYGROUND
Gymnastic apparatus for your yard. W. S. J. Thompson. Pop. Sci. Mo. 98:2:124. Feb. 1921.

PRUNE
The story of the prune. Ill. G. Orb. Sci. Am. 124:52. Jan. 5, 1921.

PSYCHOLOGY
How we think. L. A. Hausman. Sci. Am. 124:128. Feb. 12. 1921.
Psychological examinations. Ill. A. T. Poffenberger. Sci. Am. Mo. 3:205-211. Mar. 1921.

RADIUM
The Radium Institute at Paris. Ill. T. A. Marchmay. Sci. Am. Mo. 3:223-6. Mar. 1921.
Seeing things at night. Lit. Dig. 68:6:24-6. Feb. 5, 1921.

National Geographic Magazine. Washington, D. C. Monthly. 50c a copy, $4.50 a year. Best monthly journal for high grade pictures. Articles are of interest to general reader, pupils and teachers, as well as to geographers.

Nature Study Review. Ithaca, N. Y. Monthly. 20c a copy, $1.50 a year. An illustrated journal for teachers of nature study.

Popular Mechanics Magazine. Chicago. Monthly. 25c a copy, $3.00 a year. Short science items and articles well illustrated. Appeals strongly to elementary pupils. Suggest many construction projects.

Popular Science Monthly. 255 West 39th St. N. Y. C. Monthly. $3.00 a year, 25c a copy. A Review in text and pictures of the news of science and invention presented in a humanistic and inspirational way. Used as a supplement to text-books in many high schools. Valuable to science pupils and teachers.

Review of Reviews. 30 Irving Place, N. Y., N. Y. Monthly. 35c a copy, $4.00 a year. An illustrated monthly covering world affairs. Contains many good articles bearing on science, suitable for class reports.

Safety Engineering. 80 Maiden Lane, New York Monthly—$3.00 a year. 25c a copy. A journal devoted to conservation of life and property and contains much material helpful in science classes.

School Science and Mathematics. Chicago. Monthly. $2.50 a year. A teacher's journal. Includes many helpful suggestions.

Scientific American. Woolworth Building, N. Y. Weekly. 15c a copy, $5.00 a year. Has longer articles than the other popular science journals. Illustrated and is particularly valuable to high school science pupils and teachers.

Scientific American Monthly.—Woolworth Building, N. Y. Monthly ly. 60c a copy, $7.00 a year. Rather technical, but the majority of articles are usable by science teachers and some of them will do for pupil reference. Illustrated.

Science and Invention. 233 Fulton Street, N. Y. Monthly. 25c per copy, $3.00 a year. Ill. Popular articles on astronomy, physics, photography, radio-activity, medicine, and in fact, science in general.

Scientific Monthly. Garrison, N. Y. 30c a copy, $3.00 a year. Articles as a rule are more along lines of pure science. Much of value to teachers. Articles can be read to advantage by many pupils.

Transactions of the Illuminating Engineering Society. 29 W. 39th St., N. Y. Monthly. 75c a copy, $5.00 a year. Technical. Many articles contain material which can be used in high school classes.

Woman's Home Companion. 381 Fourth Ave., N. Y. C. Monthly $2.00 a year. Good articles on foods and homes.

Popular Apparatus House Moves into Larger Quarters

The Chicago Apparatus Company, formerly of 32-40 South Clinton Street has moved to 701-707 West Washington Boulevard, Chicago, where they will have double the floor space used in their old location.